WORLD PETROLEUM

July 15, 1960

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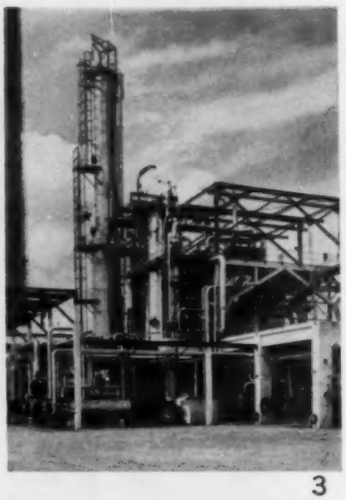

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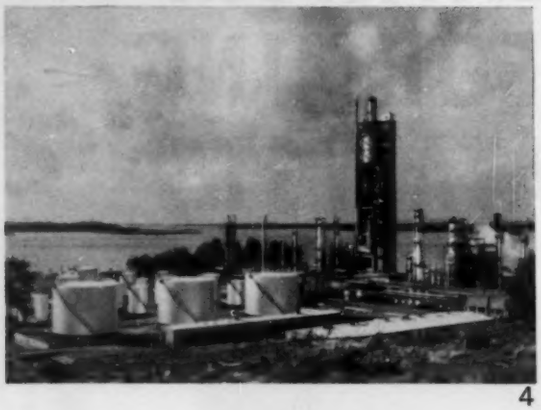

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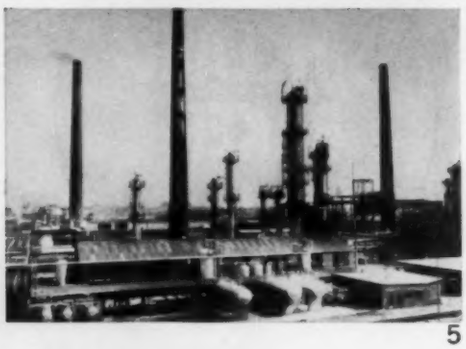

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World Petroleum

THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

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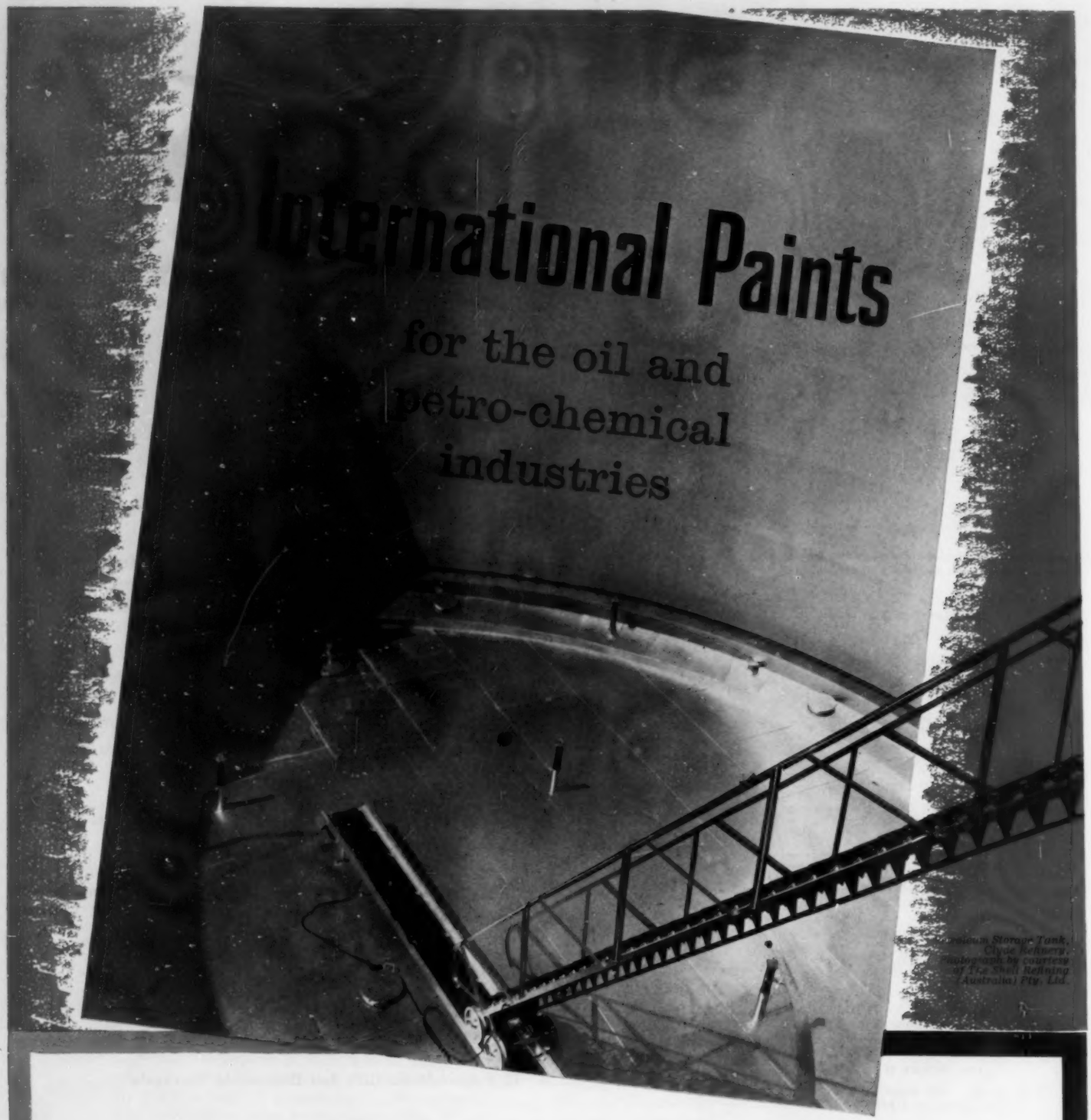
THIS MONTH'S COVER

An impression by Dom Lupo of towers at the Lake Charles, La., plant of Petroleum Chemicals Inc., jointly owned by Cities Service and Continental Oil Co. Color plates are reproduced through the courtesy of William H. Walsh, managing editor of the Cities Service house magazine service.



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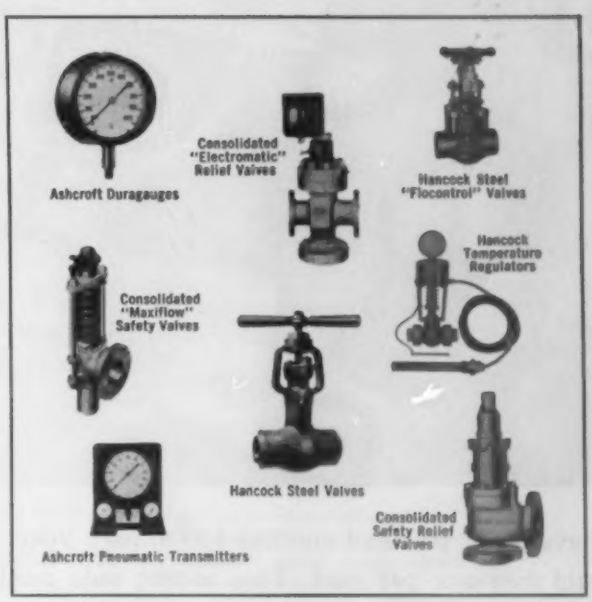

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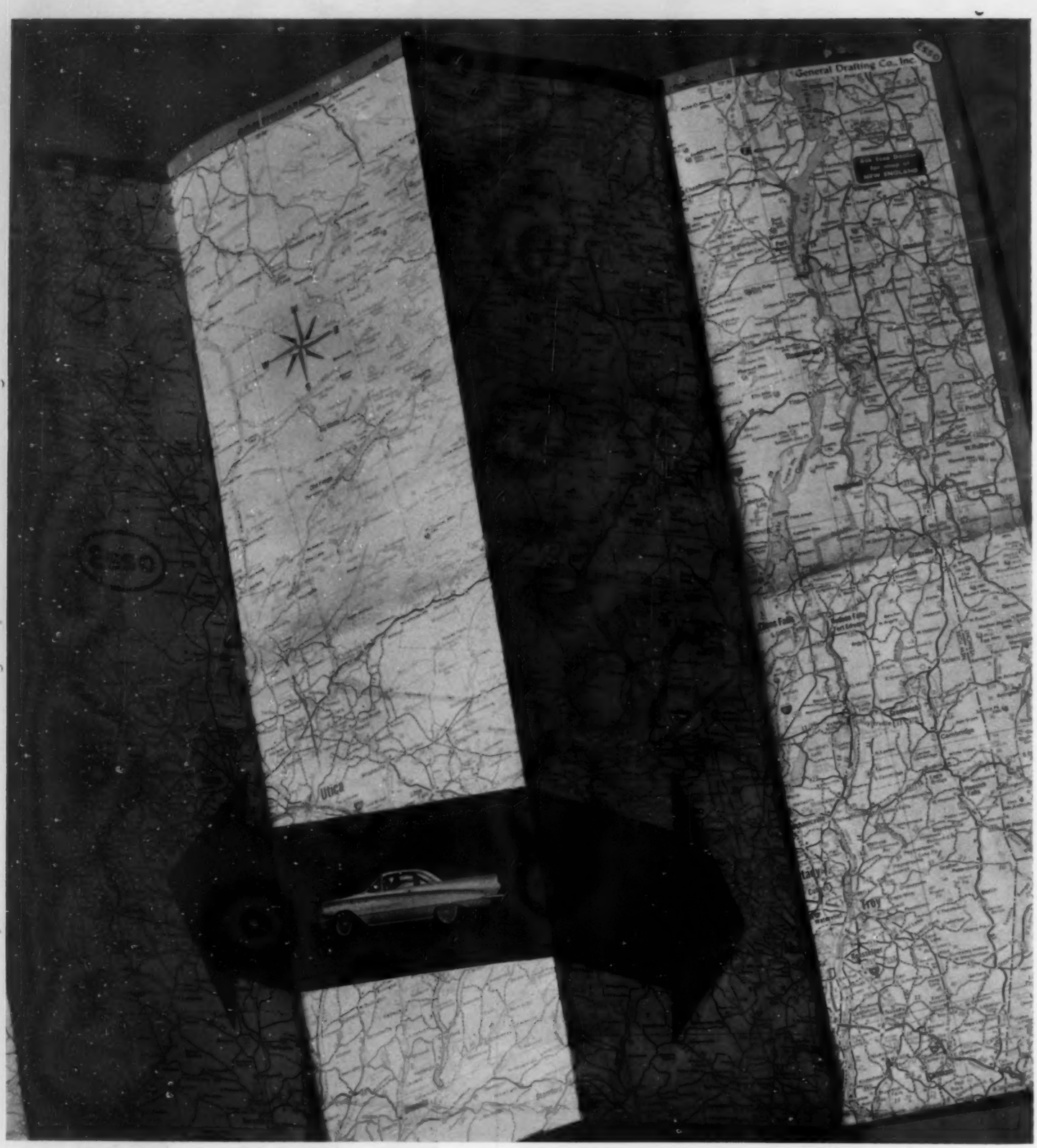

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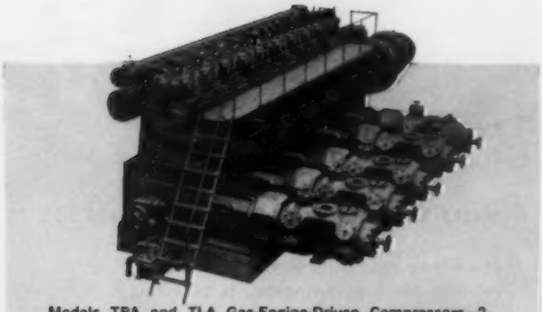

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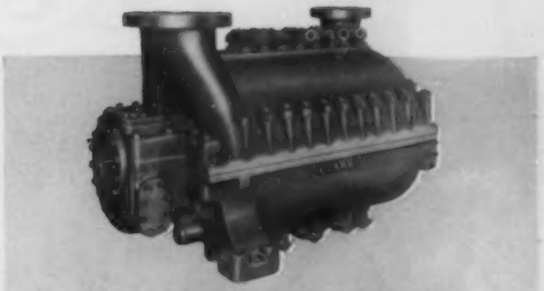

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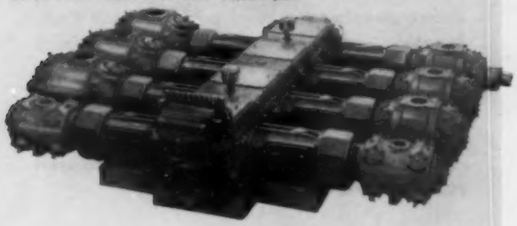

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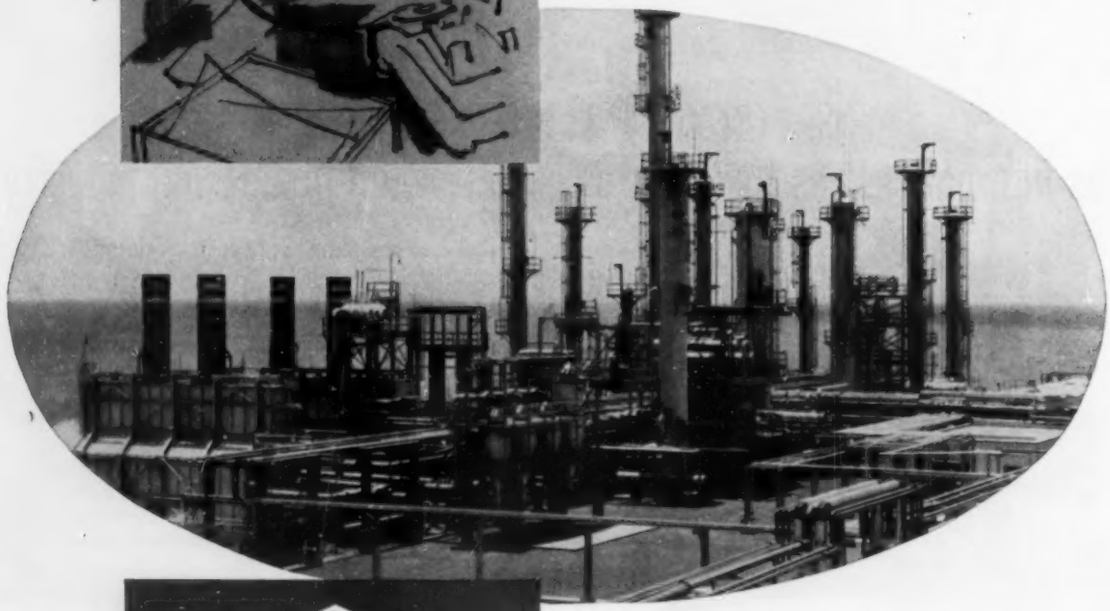

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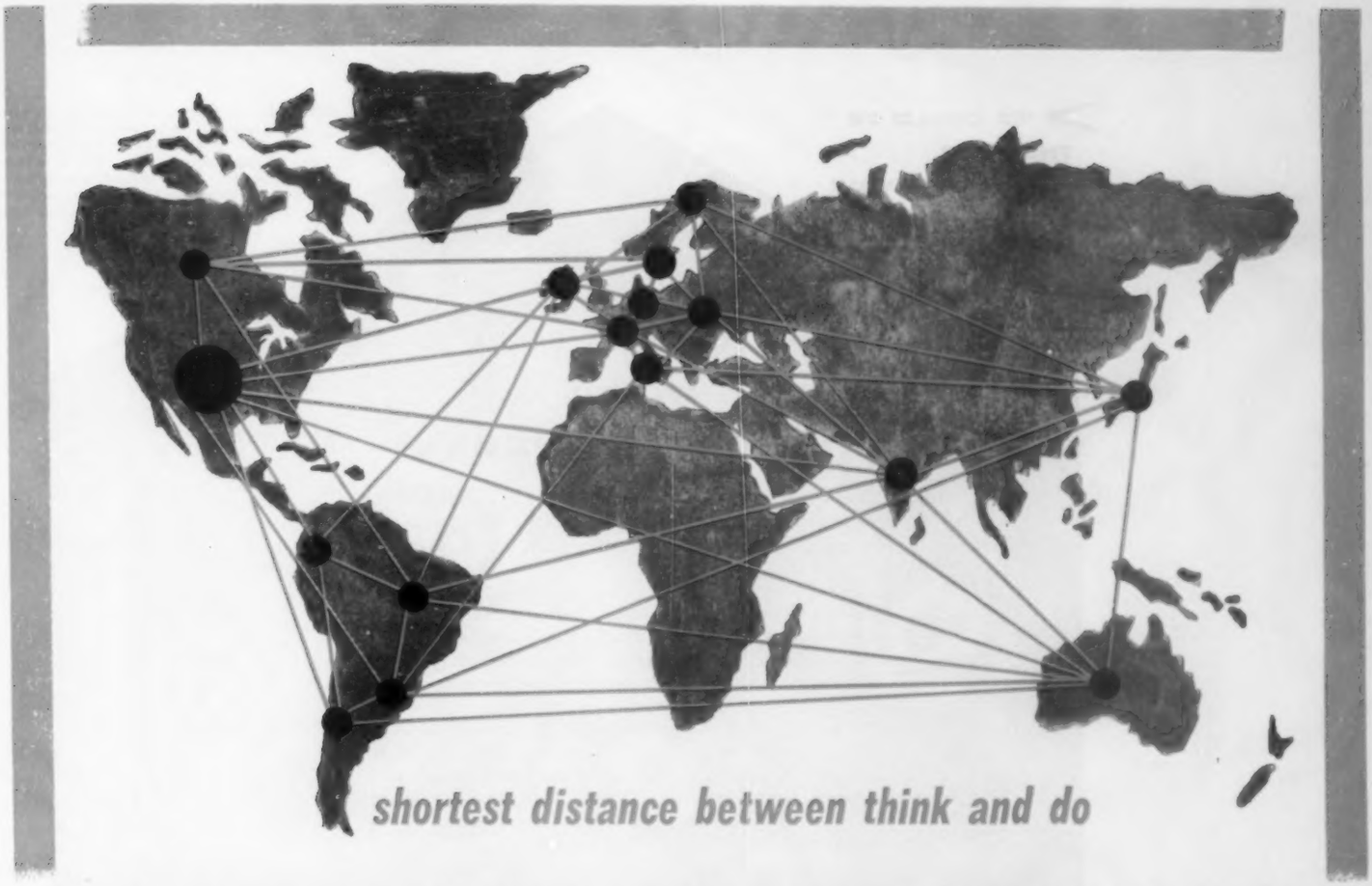

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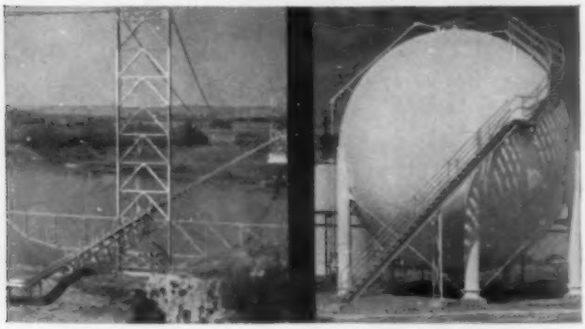

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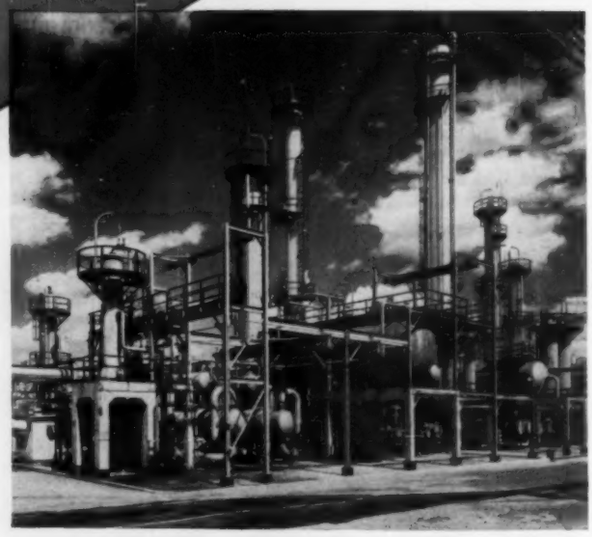

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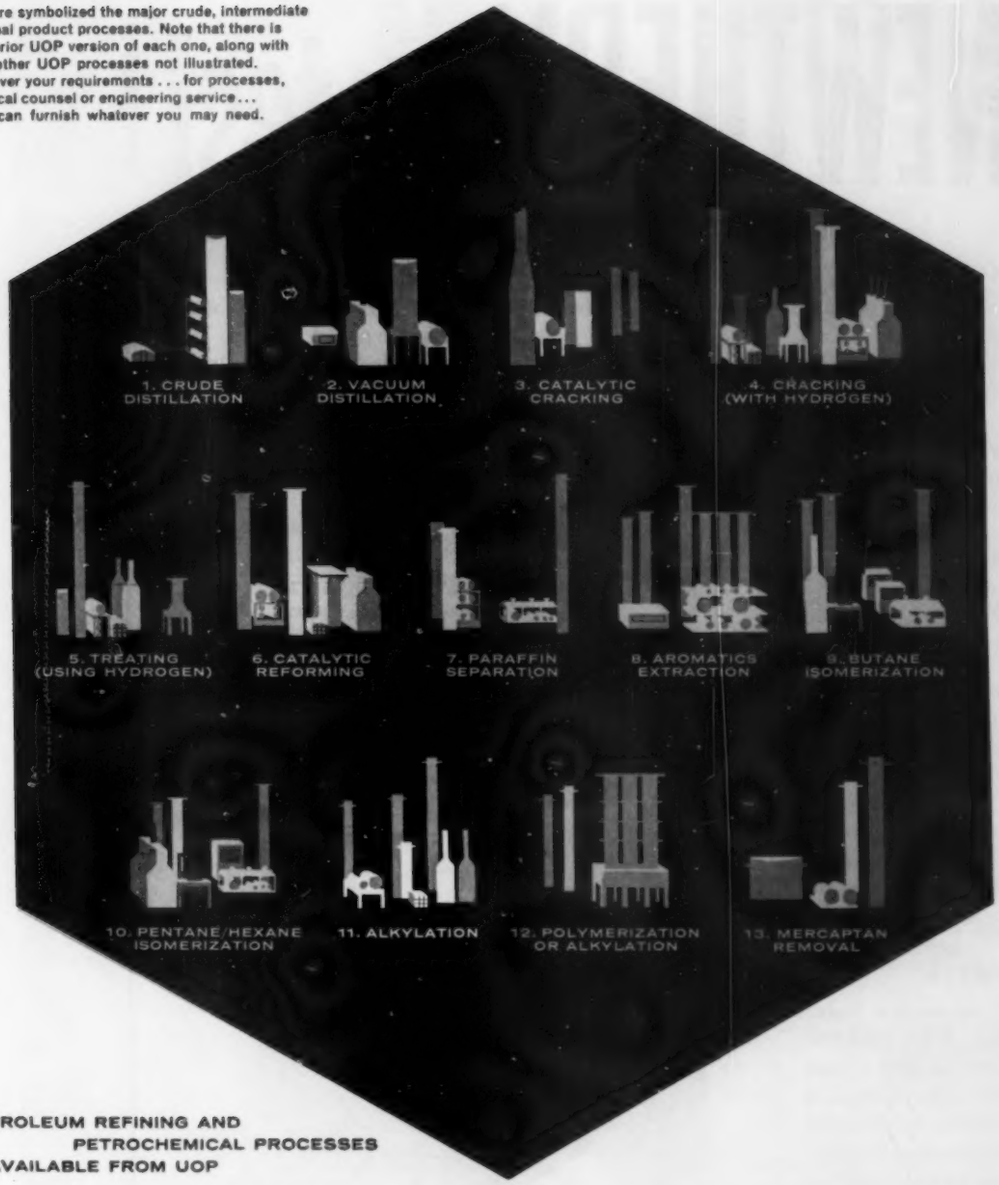

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Undoubtedly, NEWTHERM is one of the easiest of materials to apply. It is supplied in plastic form and in a wide range of standard-sized sections and slabs, smoothly finished and straight edged for immediate fitting. The finished job is very neat, with minimum joints, and appliers particularly appreciate the handleability of the material—especially in difficult situations.

READ ALL ABOUT NEWTHERM in a specially prepared booklet. Sizes, compressive strength, thermal conductivity,—this and much more useful information can be on file if you write for your copy now, to the sole manufacturers Newalls Insulation Co. Ltd.

NEWALLS (Reg'd Brand)

***NEWTHERM** calcium silicate insulation*

. . . for temperatures up to 1400°F.

NEWALLS INSULATION CO. LTD.

Head Office: WASHINGTON, CO. DURHAM, ENGLAND.

A member of the TURNER & NEWALL ORGANISATION

Offices & Depots at: LONDON, GLASGOW, MANCHESTER, NEWCASTLE UPON TYNE, BIRMINGHAM, BELFAST, DUBLIN, BRISTOL & CARDIFF.

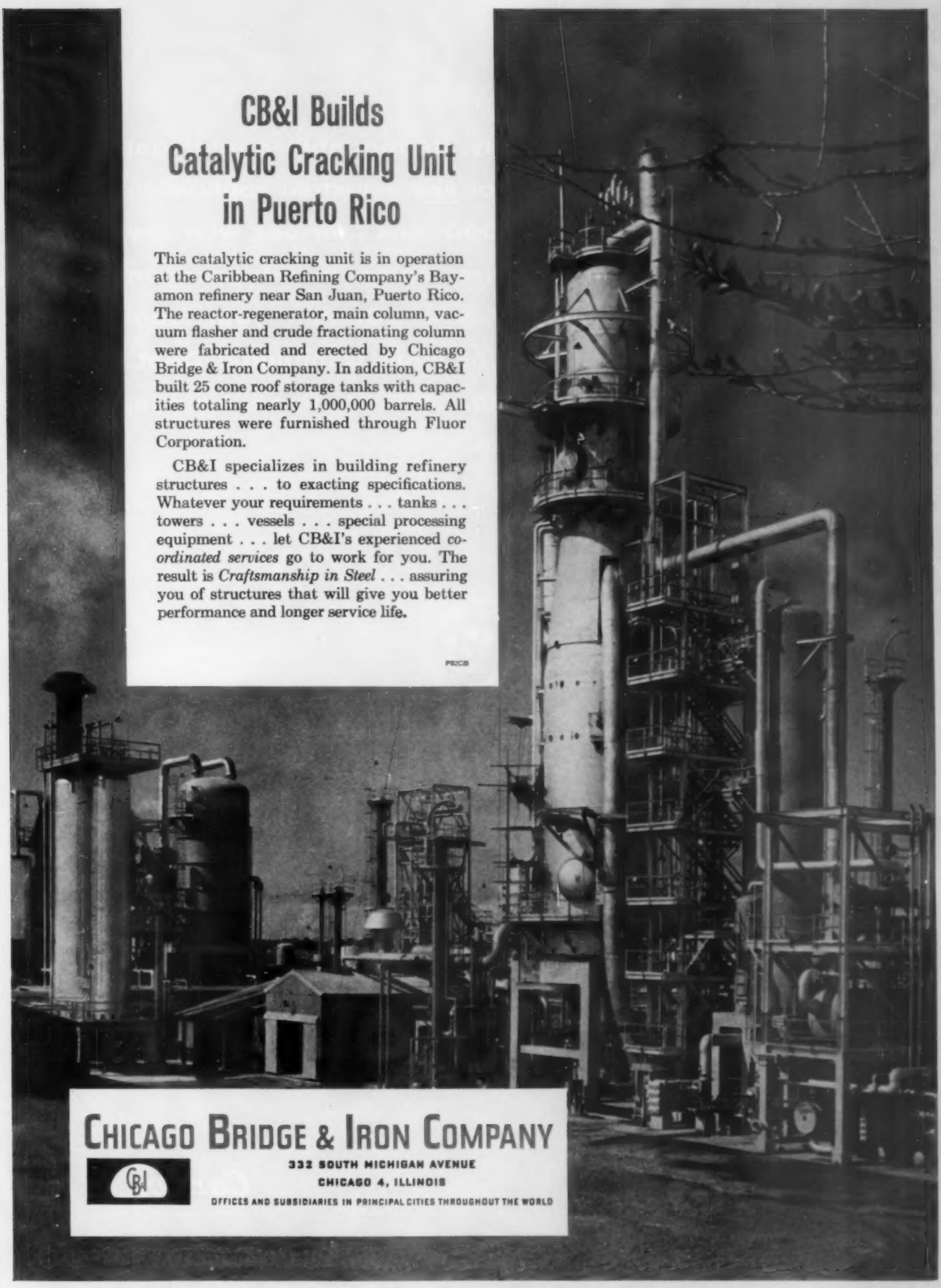
Agents and Vendors in most markets abroad.

CB&I Builds Catalytic Cracking Unit in Puerto Rico

This catalytic cracking unit is in operation at the Caribbean Refining Company's Bayamon refinery near San Juan, Puerto Rico. The reactor-regenerator, main column, vacuum flasher and crude fractionating column were fabricated and erected by Chicago Bridge & Iron Company. In addition, CB&I built 25 cone roof storage tanks with capacities totaling nearly 1,000,000 barrels. All structures were furnished through Fluor Corporation.

CB&I specializes in building refinery structures . . . to exacting specifications. Whatever your requirements . . . tanks . . . towers . . . vessels . . . special processing equipment . . . let CB&I's experienced *coordinated services* go to work for you. The result is *Craftsmanship in Steel* . . . assuring you of structures that will give you better performance and longer service life.

P92CB



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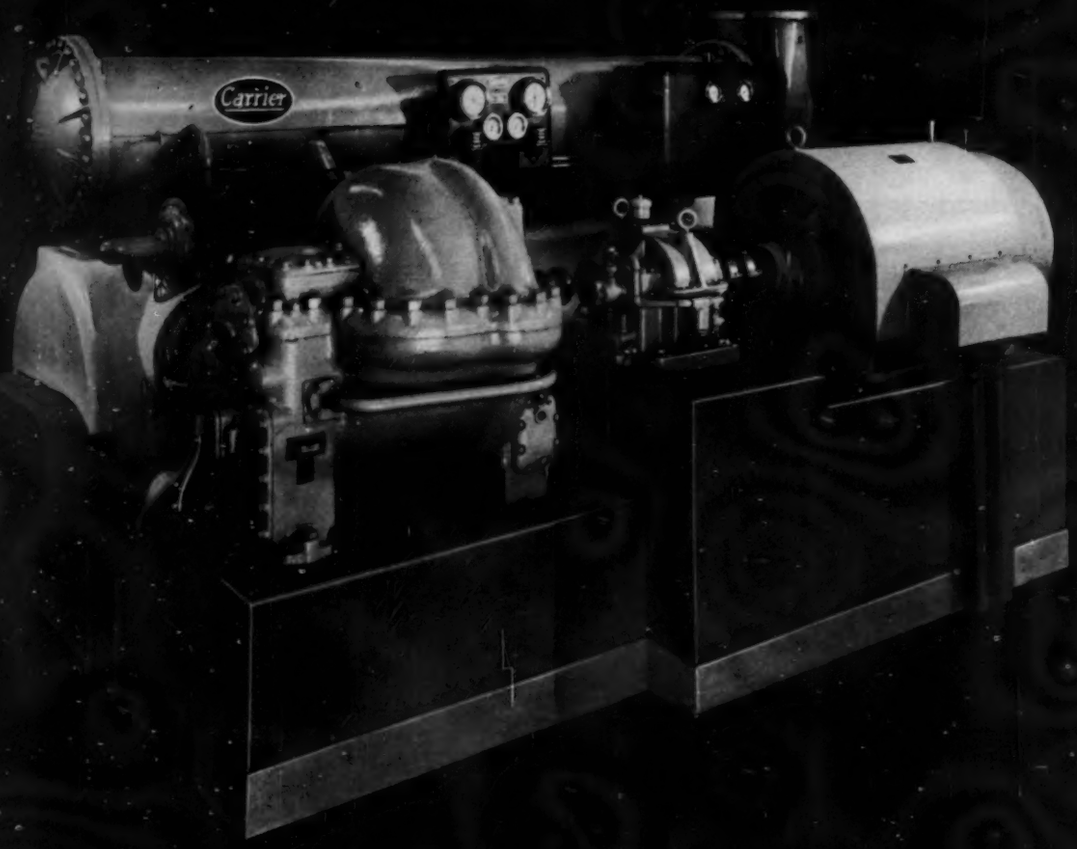
Multi-stage, heavy-duty, dependable centrifugal refrigeration machines for any industrial application ...in capacities up to 3000 tons...for use with any type drive...from the first name in refrigeration and air conditioning...Carrier. Contact your local Carrier representative, or write Centrifugal Dept., Carrier International Ltd., 385 Madison Avenue, New York 17, N.Y., U.S.A.



Carrier

Always the perfect fit

Regardless of your requirements, there is a Davison cracking catalyst to fit your refining picture: 25% Alumina for highest activity maintenance—13% Alumina for low cost octanes—Semi-Synthetic S-S for economical control of selectivity—Silica-Magnesia for maximum middle distillates. Nearly three-fourths of the refiners in the Western Hemisphere rely on Davison for superior catalysts and superior services. Contact our local field representative, or write Dept. E-07 today.

This unique kaleidoscopic photo technique is the experimental work of Cal and Don Young, Philadelphia, from a black and white photo by the Adams Studio, Odessa, Texas

DEPARTMENT E-07
W.R. GRACE & CO.
DAVISON CHEMICAL DIVISION
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A. British Oxygen. They make cutting machines for all types of jobs and *every* pipe cutting application: diameters 1″ to 24″. There's the Alyn range of pipe cutters for profile and square-cut production: the Incanto pipe cutter and end beveller; the light-weight portable pipe cutter and beveller; machines that solve every pipe cutting problem. Why not let us know what your problems are — see how we can help you.

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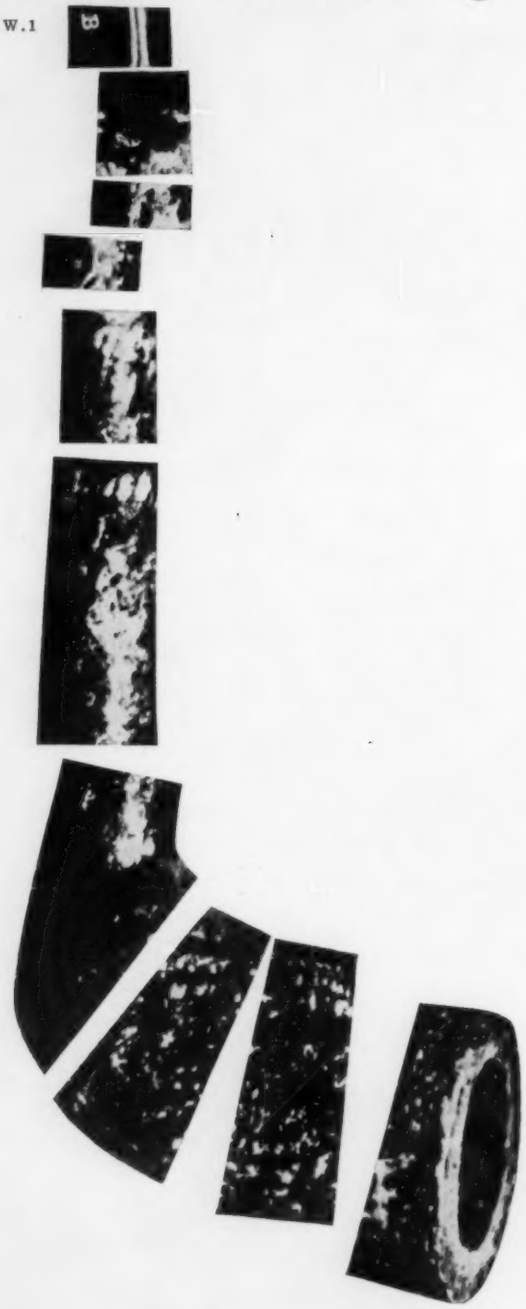
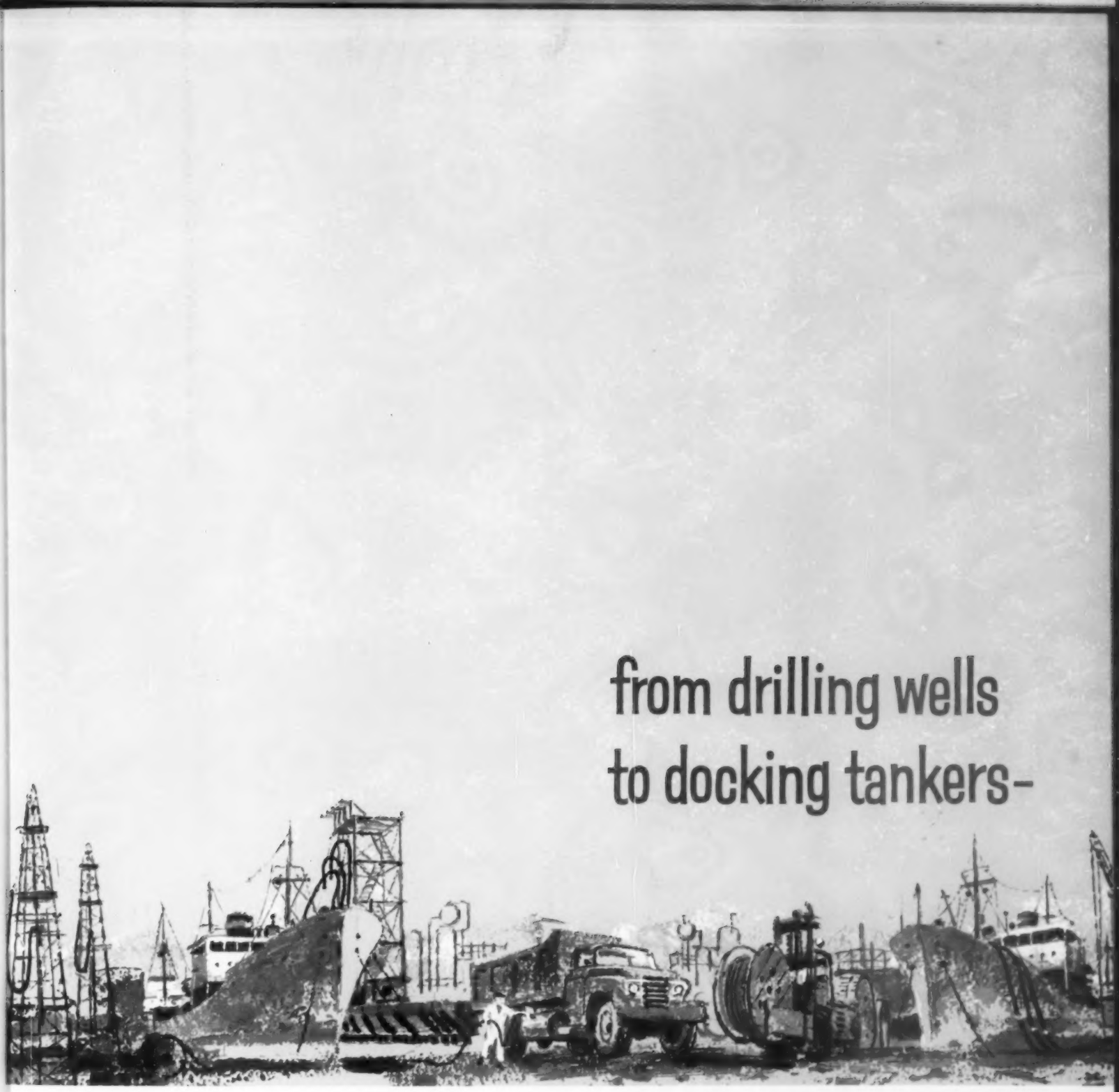




you're time and money ahead with
INDUSTRIAL RUBBER PRODUCTS BY
GOODYEAR

Here's how Goodyear users are improving their efficiency—and profits—in oil installations the world over

→

SITE: A major oil field

GOODYEAR PRODUCT: 3153H Rotary Drilling Hose

PERFORMANCE: Although drilling through rock strata so hard it took 30 days to go down 2,100 feet, this Goodyear Hose completed 171,800 feet of hole—25 complete wells—and still looked good for much more service

Veteran oil-field men everywhere prefer Goodyear Rotary Drilling Hose for one simple reason:

It outperforms—and outlasts—the others even where the toughest rock strata and most extreme bottom-hole pressures present special hazards.

Secret of its success is unsurpassed ruggedness of construction that also makes it highly resistant to crushing, kinking, and weathering.

SITE: Large refinery port

GOODYEAR PRODUCT: Style MH Oil Suction & Discharge Hose

PERFORMANCE: Three times the expected service—even when unloading up to 138,000 barrels of gasoline in 10-hour periods

Using Goodyear Oil Suction and Discharge Hose is your best insurance against tie-ups or premature failures.

For this hose is designed for the toughest kind of oil-handling service. It stands up under plenty of rough handling—outlasts ordinary oil hose by a wide margin.

You can count on Goodyear Oil Suction and Discharge Hose for the longest, most trouble-free handling of oil, gasoline, solvents—even asphalt.

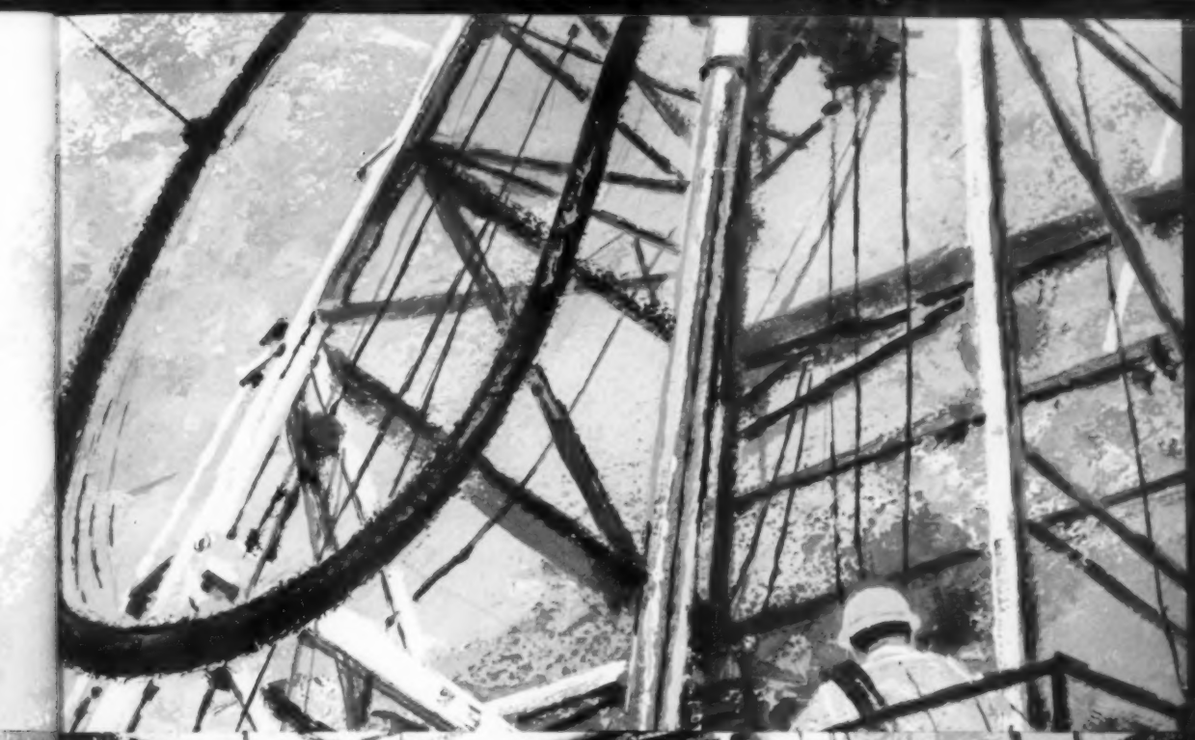
Also available in smooth bore types for working pressures up to 250 psi.

SITE: Industrial plants the world over

GOODYEAR PRODUCT: ORTAC Hose

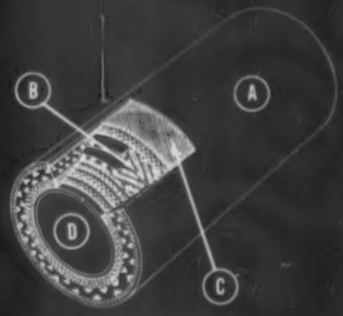
PERFORMANCE: ORTAC handles oils, grease, solvents, some chemicals, water and air. That eliminates the need for big hose inventories—saves users money

ORTAC Hose is designed and built to do the jobs that formerly required five different hoses. It is ruggedly constructed—with high burst strength, unusual resistance to strains and great flexibility. Both its tube and cover are oil-resistant.



GOODYEAR INDUSTRIAL PRODUCTS

3153H Rotary Hose for high-pressure drilling



A Cover of extra-heavy-gauge compound resists gouging, weathering and wear

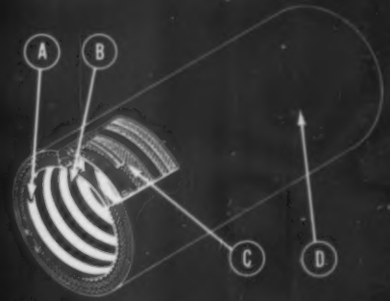
B Plies of heavy fabric plus high-tensile cable steel wire and wire helices at ends for exceptional strength with flexibility

C Fabric breaker strip

D Heavy mud-, abrasion- and oil-resistant tube

GOODYEAR INDUSTRIAL PRODUCTS

Style MH Oil Suction & Discharge Hose (RB)



A Helix of flat, noncorroding, galvanized steel wire plus ply of heavy fabric coated with oil-resistant compound

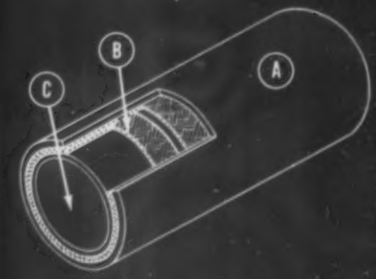
B Tube of gasoline- and oil-resistant synthetic rubber

C Reinforcing plies of heavy fabric plus helix of round steel wire

D Oil-, age-, abrasion-, and weather-resistant cover

GOODYEAR INDUSTRIAL PRODUCTS

ORTAC Hose for multi-purpose industrial use



A Sturdy cover is oil-, sun-, weather-, cut-, and abrasion-resistant

B High-tensile synthetic cord reinforcement for exceptional flexibility and strength

C Nonporous, seamless, highly oil-resistant tube

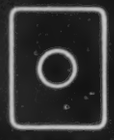
GOODYEAR INDUSTRIAL PRODUCTS

Dock Fenders for All Uses

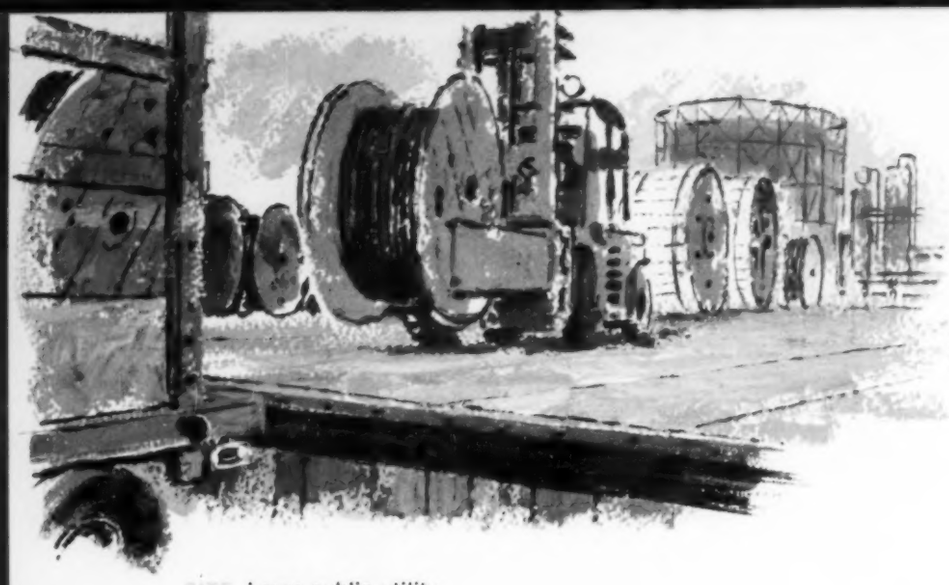
Type M-4
4½" x 3½"

Wing-Type
3" to 10" O. D.

Cylindrical
3" to 21" O. D.



Rectangular
2" x 4"
to 12" x 12"



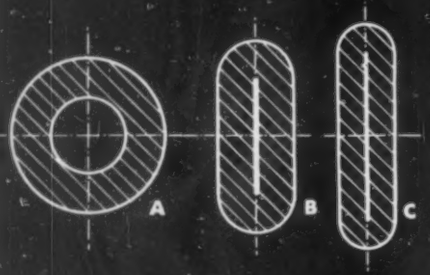
SITE: Large public utility

GOODYEAR PRODUCT: All-Rubber Truck Dock Fenders

PERFORMANCE: 30-feet of Goodyear all-rubber fendering proved so successful in eliminating frequent repairs to a dock, the company had 265 feet of it installed on their new cable-loading platform. It proved equally successful there.

GOODYEAR INDUSTRIAL PRODUCTS

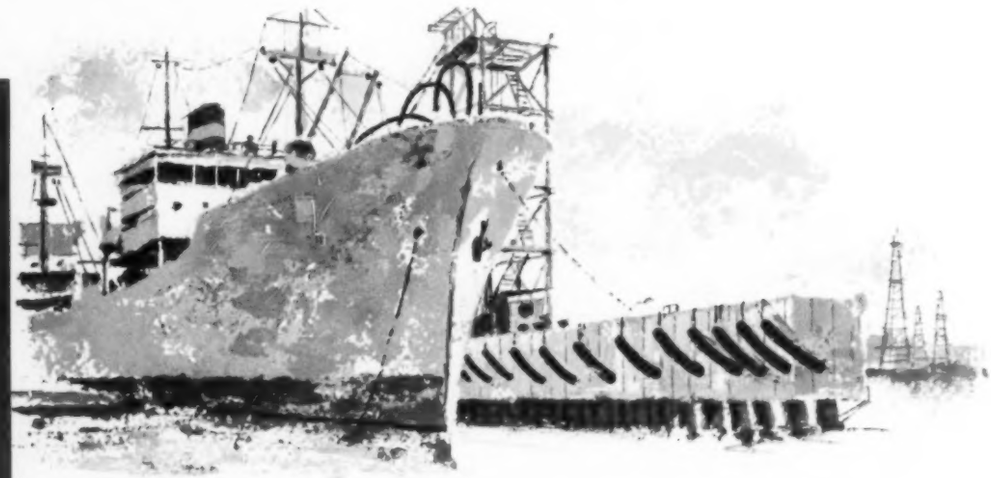
Cylindrical Dock Fenders for protection against shock, abrasion and crushing action



A Uncompressed 15" O. D. 7½" I. D.

B Compressed 7½" (bore closure) under approximate load of 5 tons per foot

C Compressed 11" under approximate load of 110 tons per foot



SITE: Large oil company

GOODYEAR PRODUCT: All-Rubber Dock Fenders

PERFORMANCE: Goodyear all-rubber fendering was installed to absorb the extra-heavy shock when this firm built a new berthing station for super-tankers. Result: after years of hard service, the fenders still needed no maintenance of any kind. Savings have been far greater than the company anticipated

As you can easily see in these pages, Goodyear Industrial Rubber Products are saving time and money for oil-field men the world over.

And that's only a sample of the standout performance you can expect from Goodyear Hose, V-Belts, Conveyor Belts, or other industrial products used from the wells right to the shipping docks.

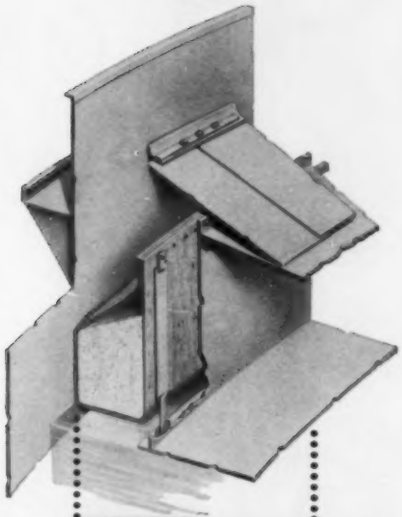
For full information on any one of them, contact your nearest Goodyear Office. Or write Goodyear International Corporation, Akron 16, Ohio, U.S.A.

GOODYEAR PRODUCTS ARE MANUFACTURED IN: Argentina, Australia, Brasil, Canada, Colombia, Cuba, Eire, England, Germany, India, Indonesia, Japan, Luxembourg, Mexico, New Zealand, Peru, the Philippines, Scotland, South Africa, Sweden, the United States, Venezuela. Branches, Distributors and Dealers throughout the world.

GOODYEAR

Ortac—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio, U.S.A.

FIRST solid cushion seal



When General American developed EverSeal, first solid cushion seal for floating roofs, we wanted a seal that would have these advantages:

1. Simplicity of design, no moving parts, nothing to corrode
2. Permanent, indestructible sealing qualities—no gas or liquid to leak
3. Complete protection of coated tank walls from scuffing or gouging
4. A tough, pliable envelope that would withstand abrasion; ride without damage over projections on the shell
5. Ease of repair or replacement, without taking tank out of service
6. Maximum protection against evaporation loss
7. Full protection of oxygen-sensitive stocks
8. No build-up of vapors in the seal area

EverSeal is the *first* solid cushion seal to meet *all* these requirements. It is made of trapezoidal urethane foam cushions enclosed in a tough, scuff-proof envelope of Buna "N" synthetic rubber and polyvinyl chloride plastic.

EverSeal is almost impossible to damage, always provides a safe and complete seal for every floating roof.

Write or phone your nearest General American office for complete information.

It pays to plan with General American.

EverSeal*

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- Rotary tables
- Compounds
- Air compressors
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- Air hoists
- Water pumps
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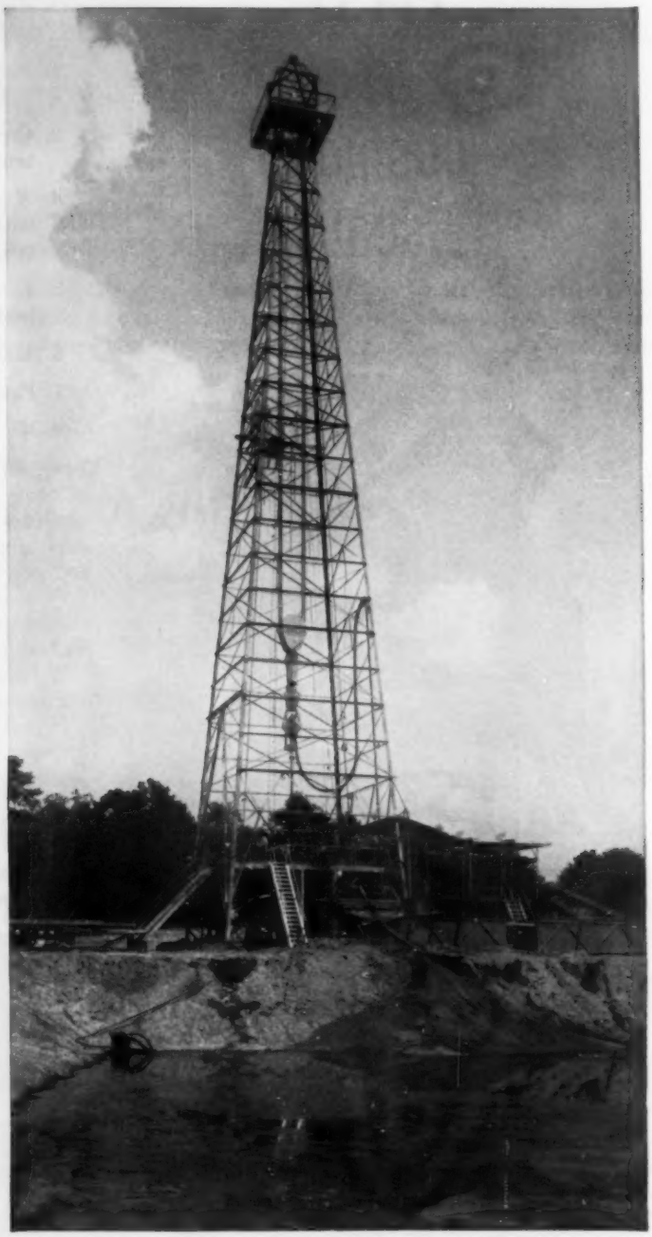
- Impact wrenches



Gardner-Denver is keeping pace with oil industry progress in the development of equipment today for the challenge of tomorrow. Ask your Gardner-Denver petroleum industry specialist about these great new products for deepest drilling.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

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We manufacture a full range of FORGED STEEL FITTINGS.

They are available screwed A.P.I. line pipe or British Standard taper pipe thread or with socket weld ends.

A section of the I.C.I. Nobel Division plant at Stevenston where Silicone Oils are manufactured.

Reliable always

NEWMAN, HENDER FORGED STEEL VALVES

Refinery engineers find many applications for Newman, Hender Forged Steel valves and fittings. Their adaptability to refinery purposes is only matched by their really outstanding reliability and ease of working.

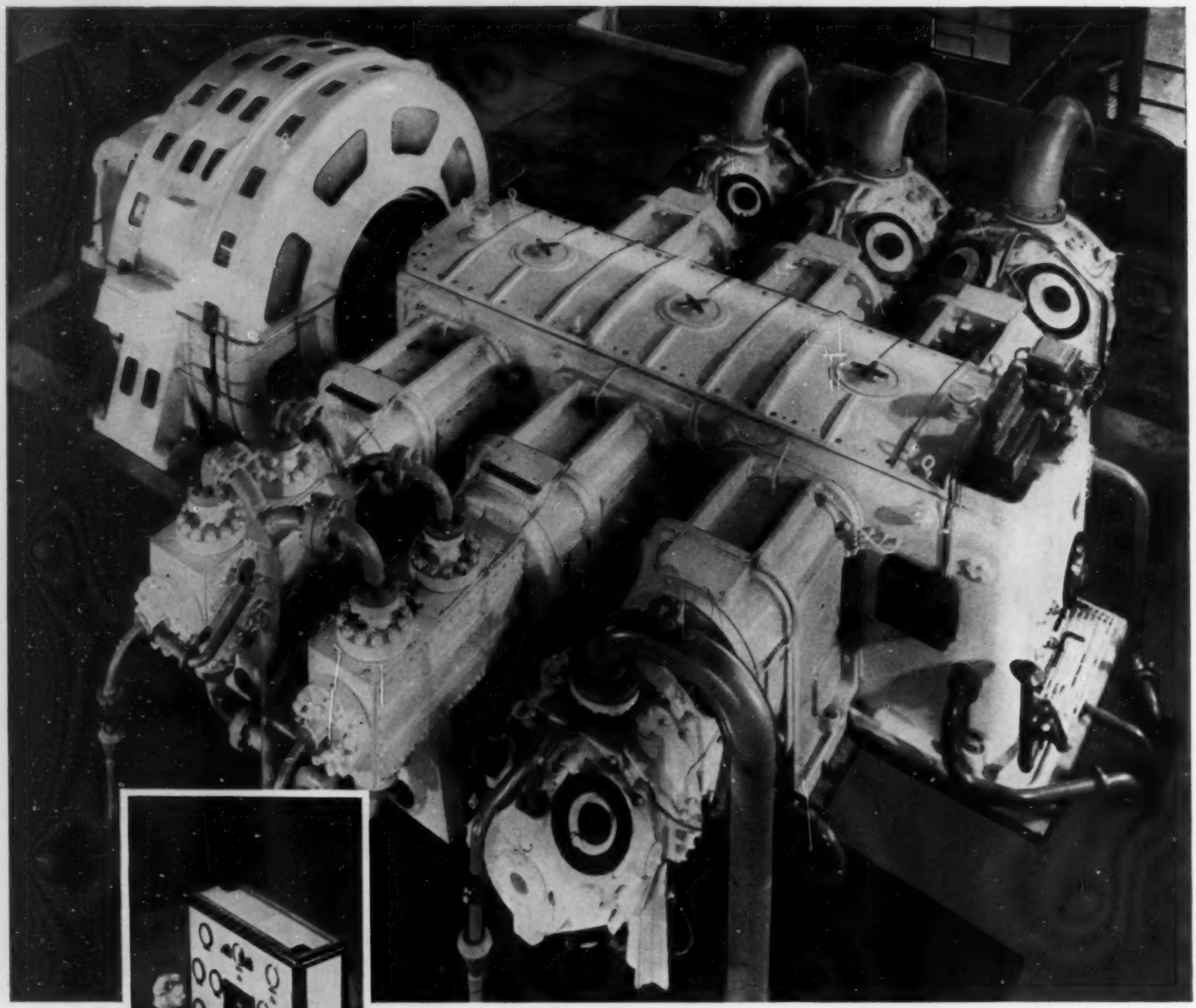
The yoke sleeves can be replaced in service without removal of the stem or bonnet. Seats are rolled into the bodies of the valves and the wedges are positively guided by precision machined slots in the bodies. The result is leak-proof, trouble-free valves. Always tight and easy to operate.

Descriptive literature on application

NEWMAN, HENDER & Co., Ltd.

WOODCHESTER, Stroud, Glos.

Telephone: Nailsworth 360. Telex: 4375.



COMPRESSORS FOR INDUSTRY

One of a number of Brotherhood six crank five stage compresssors supplied to The British Oxygen Company Ltd. Each compressor has a capacity of 8,670 m^3/hour, delivery pressure 185 atmospheres, driven by 3,050 H.P. synchronous motor.

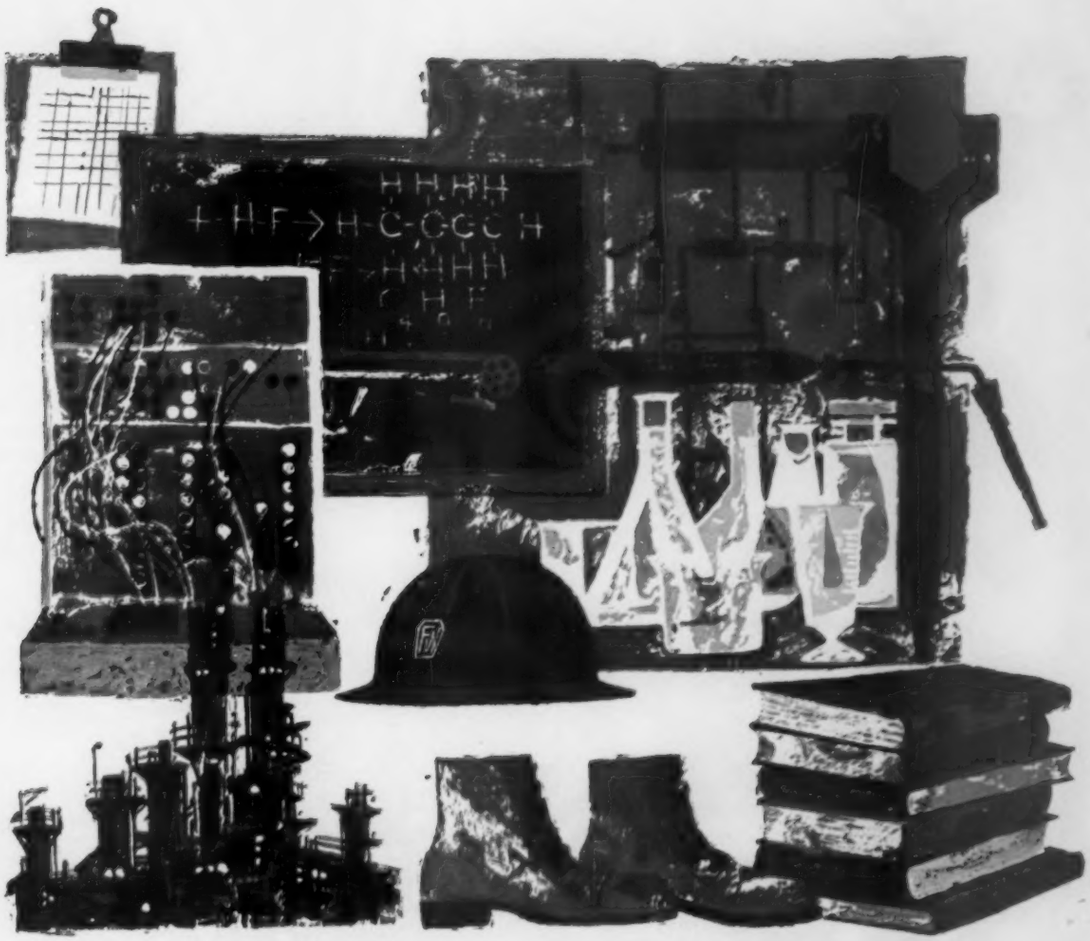
Brotherhood compressors are designed to customers' exact requirements.

PETER BROTHERHOOD LTD.

PETERBOROUGH ENGLAND

Compressor and power plant specialists for nearly a century

P3629



a single source for all you need to make your process ideas succeed

Your ideas will thrive best in the company of people experienced in developing the ideas of others.

At Foster Wheeler you will find everything you need to make your process ideas a commercial success. There are men skilled in laboratory research and commercial evaluation to probe the practical possibilities of your ideas. To design and engineer your process plant there is a community of engineering professions—structural, heat and power, chemical, hydraulic, process . . . experts on pressure vessels and instrumentation . . . and people experienced in project management, plant construction and start-up.

From this comprehensive approach you can expect profitable operation at rated capacity soon after completion.

Two recent examples are plants delivered in good time and in good working order, operationally ready for quick write-off. They are a new ammonia plant producing in excess of 300 ton/day that exceeded rated capacity within 30 days of start-up; and a complete lube oil plant built in the Middle East which was in full production less than two years after award of the contract.

Before you specify, consult with Foster Wheeler. We are ready when you are. Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, New York.

Heat Engineered products, plants and processes . . . for the world's industrial progress.

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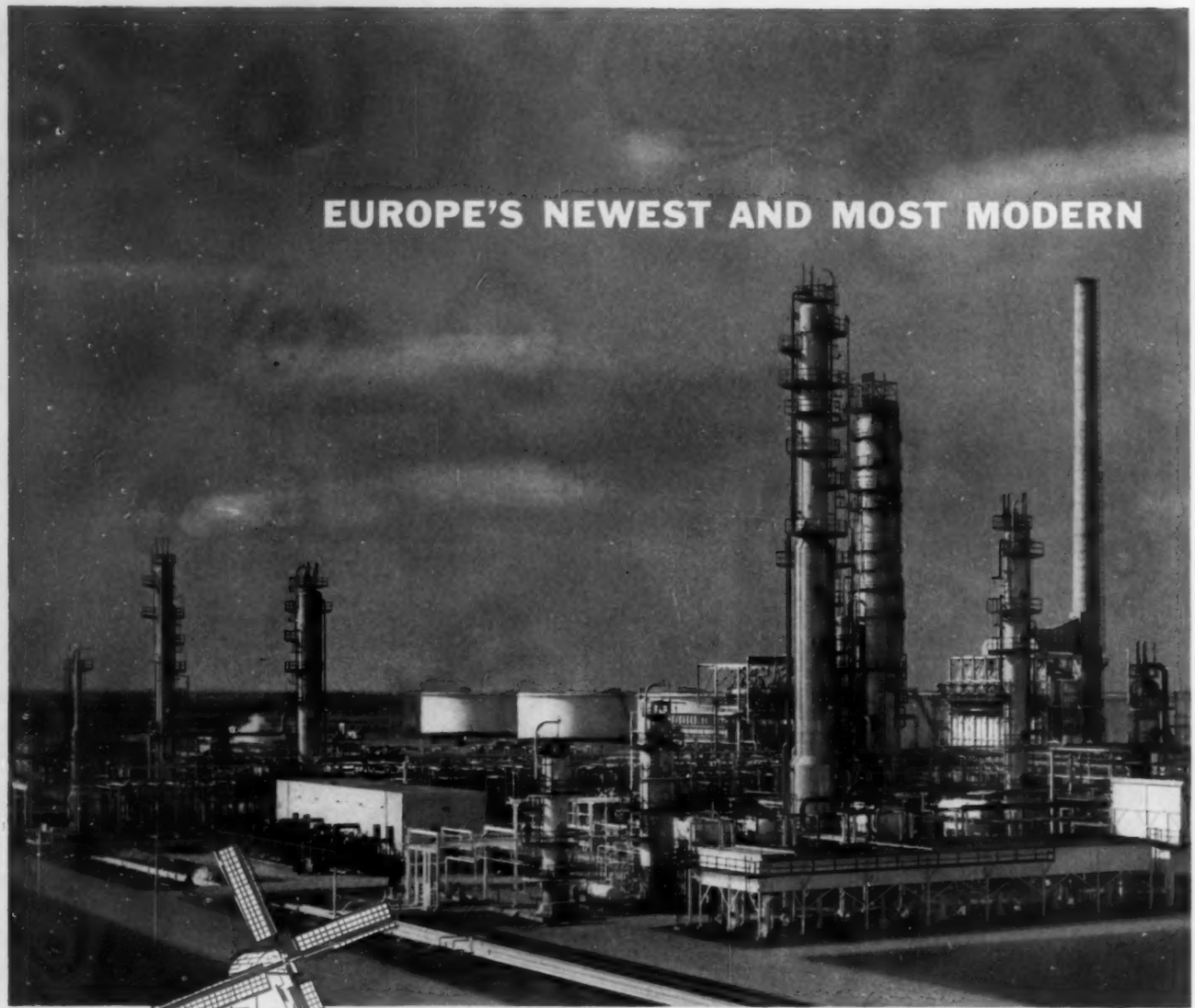


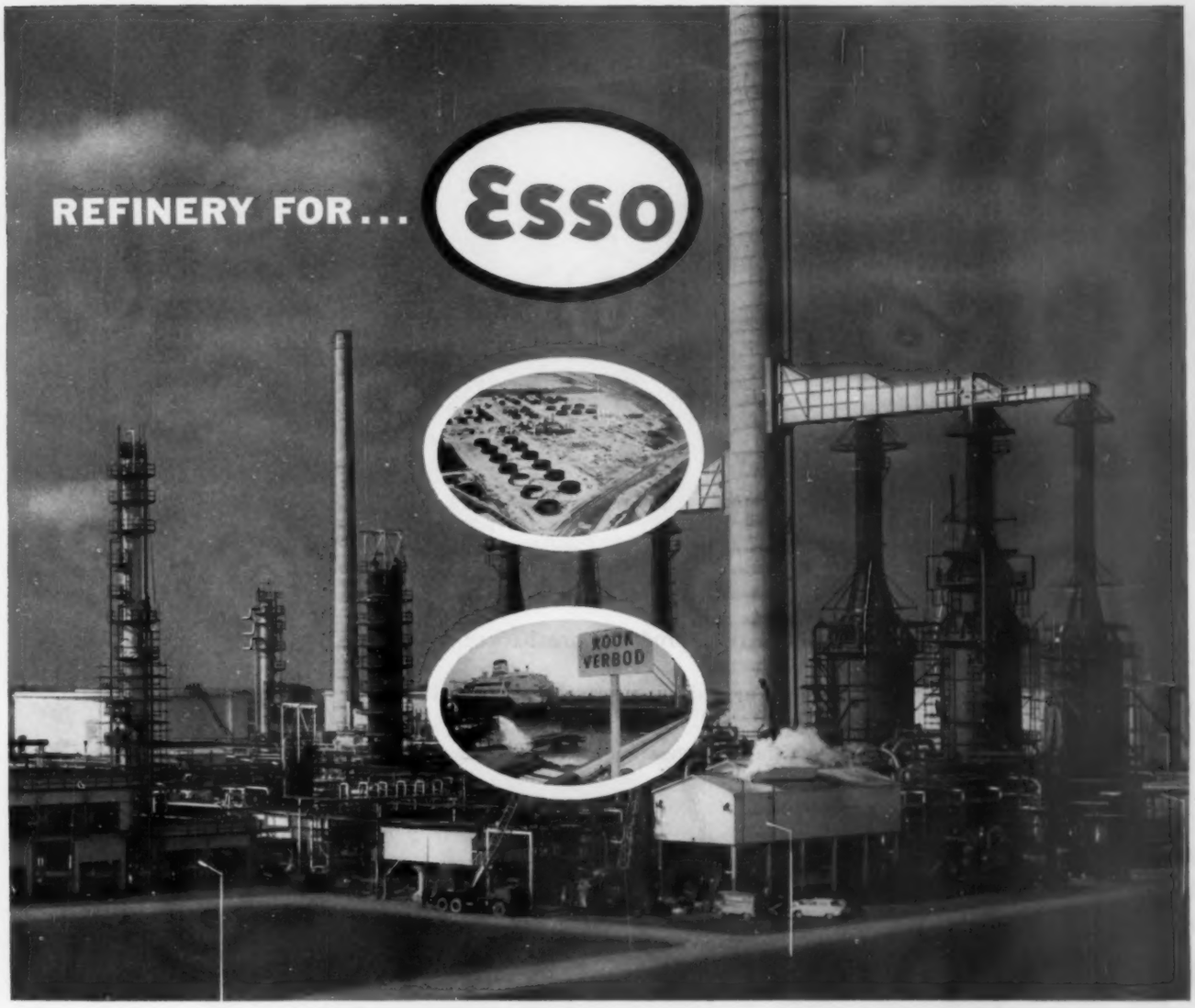
From Polder to Production in 24 Months

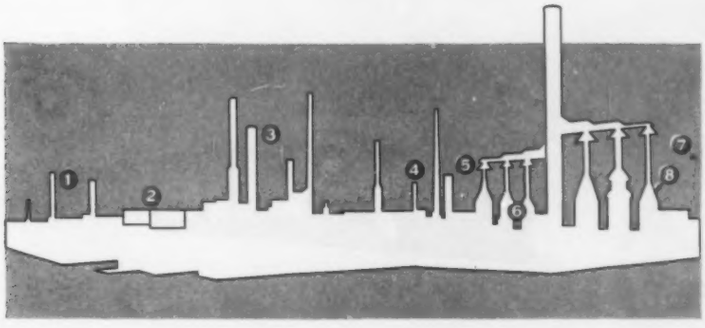
In a country which has long been accustomed to engineering miracles, Esso Nederland's new "grass-roots" refinery in Rotterdam is being acclaimed a technical and logistical feat of the first rank. For here, on a "site" that a scant two years ago was a polder barely higher than the bordering River Maas, Badger N.V. has engineered and built a mammoth processing complex covering some 275 acres.

The 100,000 bpsd refinery is the largest in Europe which is completely air cooled, completely electronically controlled and equipped with fully automatic product loading facilities. At one time 2600 men, drawn by Badger from a dozen different countries, were directly engaged in its construction. This army of specialists handled over 30,000 tons of steel . . . 10,000 tons of cement . . . miles of electrical cable, timber and pipe.

The work started, as most Dutch construction projects start, with "creating" land — 10 million yards of fill, supplied by the municipality of Rotterdam, were laced by more than 2000 piles, 80 feet long. On this underpinning Badger crews procured and erected the process units, storage tanks, waterfront and offsite facilities.

This refinery is another example of the reason why Badger and its overseas affiliates have established a world-wide reputation for making tough projects look easy. Whether you are thinking in terms of a small unit or major plant, it's the type of service you deserve. Please write or call for complete information on Badger services.





The main process units of the Esso Nederland Refinery consist of ❶ Naphtha Stabilizer ❷ Crude Storage ❸ Crude Distillation ❹ Diesel Oil Hydrofiner ❺ Steam Plant and Water Treating Plant ❻ Powerformer ❼ Tanker, barge, rail and truck loading facilities ❽ Copper Chloride Treater. Blending Units are at right out of picture.

Waterfront facilities for the refinery cover 2260 meters and include two piers each capable of simultaneously handling a supertanker of up to 50,000 dwt.

built by

BADGER

INTERNATIONAL DESIGNERS

ENGINEERS • CONSTRUCTORS

THE BADGER COMPANIES

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All Reyrolle products are backed by highly organised research and development facilities to ensure the excellence of performance for which they are noted

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AIR-BLAST SWITCHGEAR
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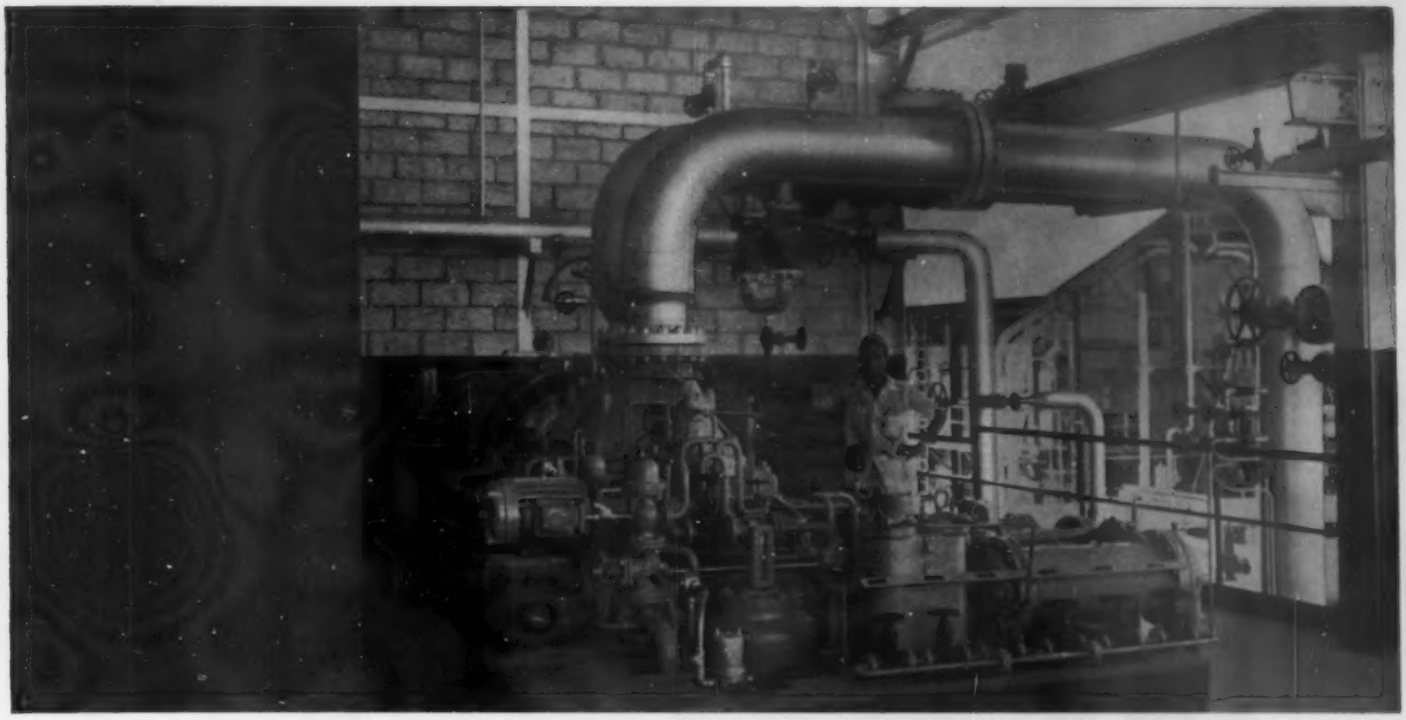
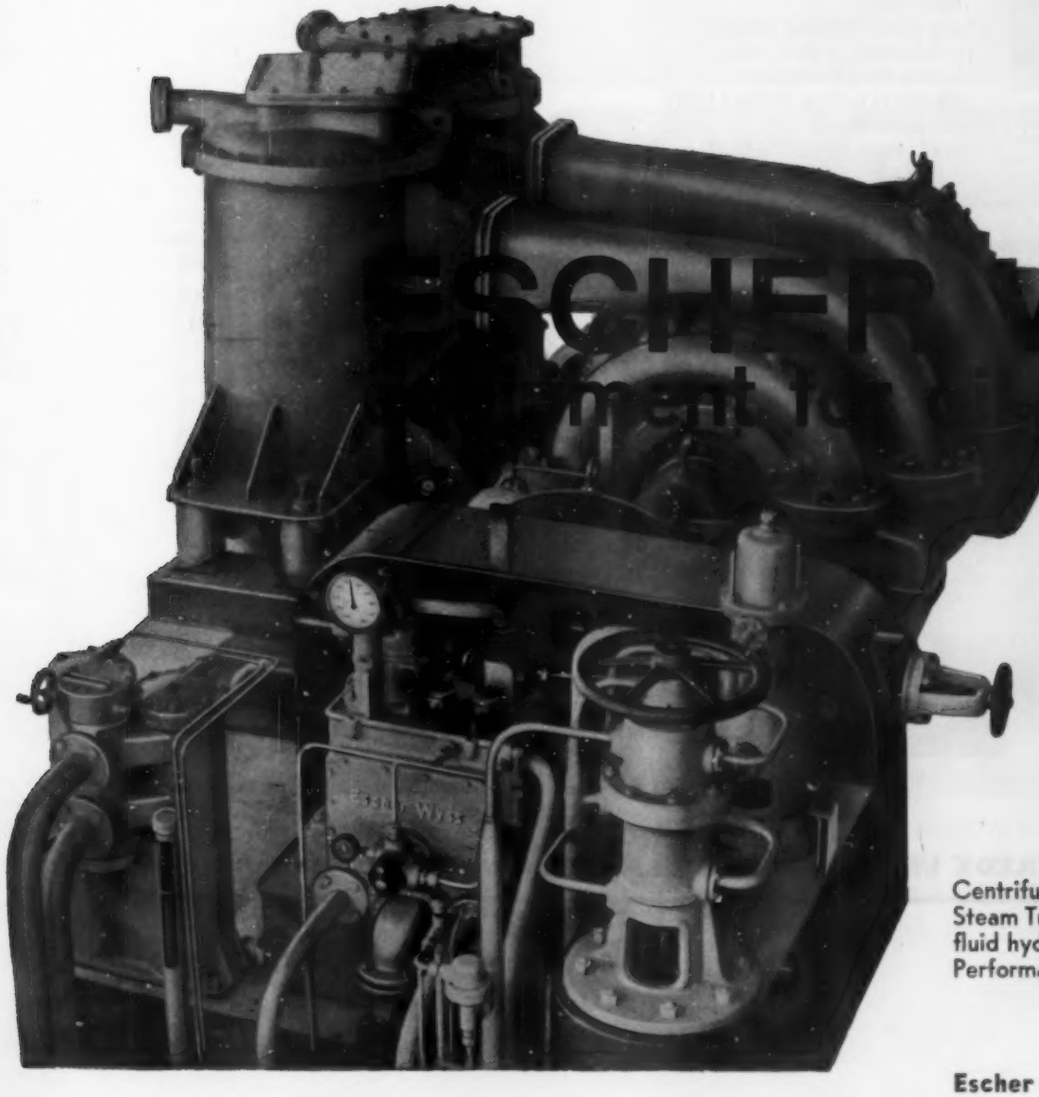


Centrifugal Recycle Gas Compressor with sealing oil system, installed in an oil refinery



ESCHER WYSS

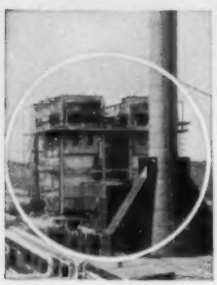
efineries

Centrifugal Compressor with Condensing Steam Turbine, supplying combustion air to a fluid hydroformer installed in an oil refinery. Performance: 11,250 cfm, 260 psia, 8150 rpm

Escher Wyss Ltd. Zurich/Switzerland

BABCOCK

Equipment for the Oil and Chemical Industries



Babcock boilers each for 134,000 lb. steam/hr., fired with oil, asphalt or refinery gas; at Shell's Shellhaven refinery.

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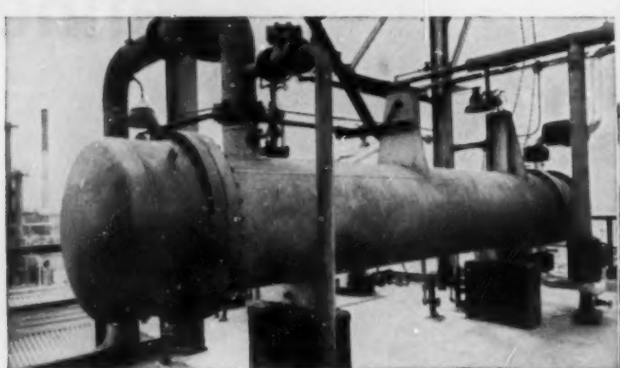
COMPLETE STEAM-RAISING PLANTS,
TREATING TOWERS,
MANIFOLDS
and other PRESSURE VESSELS,
in mild-steel or clad plate;
and for HEAT-EXCHANGERS,
SEPARATELY-FIRED SUPERHEATERS
and plant for the
UTILIZATION OF WASTE HEAT.

Many of the world's largest pressure vessels have been Babcock fusion-welded, including the giant heat-exchangers of Britain's first atomic power stations and a large number of treating towers for the world's oil refineries and chemical plants. The Company has, indeed, an exceptional experience of fabrication by fusion-welding and, as the world's largest maker of steam-raising plant, has a thorough understanding of the principles and problems of heat-exchange.



Heat-exchanger built by Babcock, in service at an oil refinery.

Distillation unit at an oil refinery, comprising Babcock fusion-welded columns.

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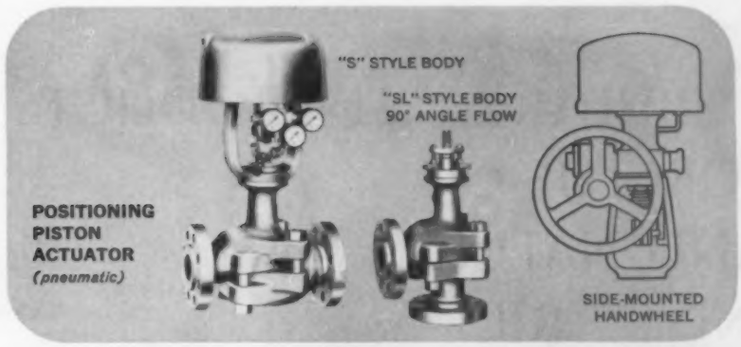

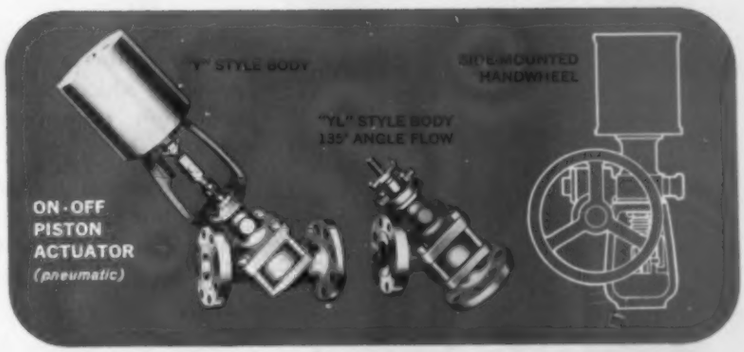

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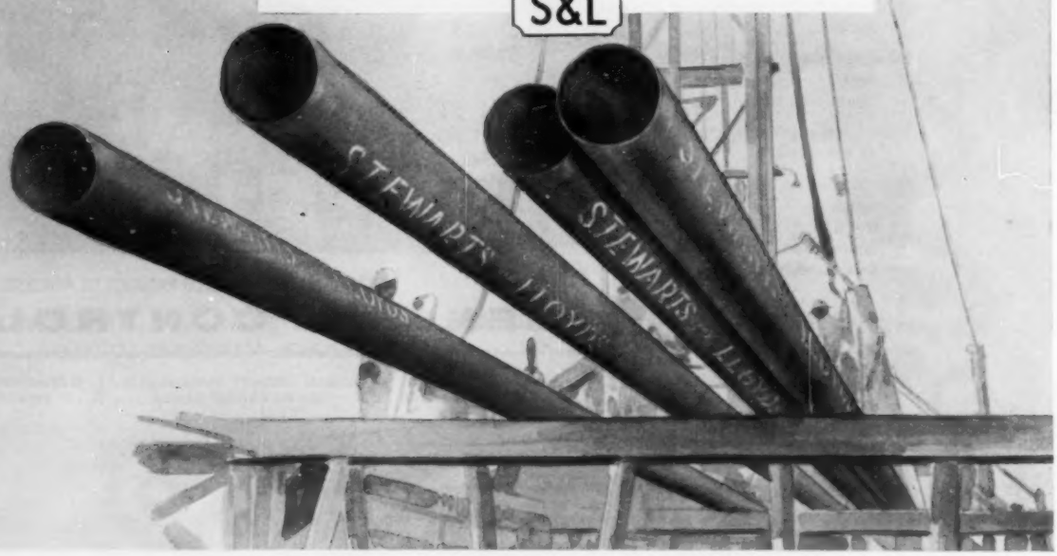

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Literature on all aspects of our products is available on request.

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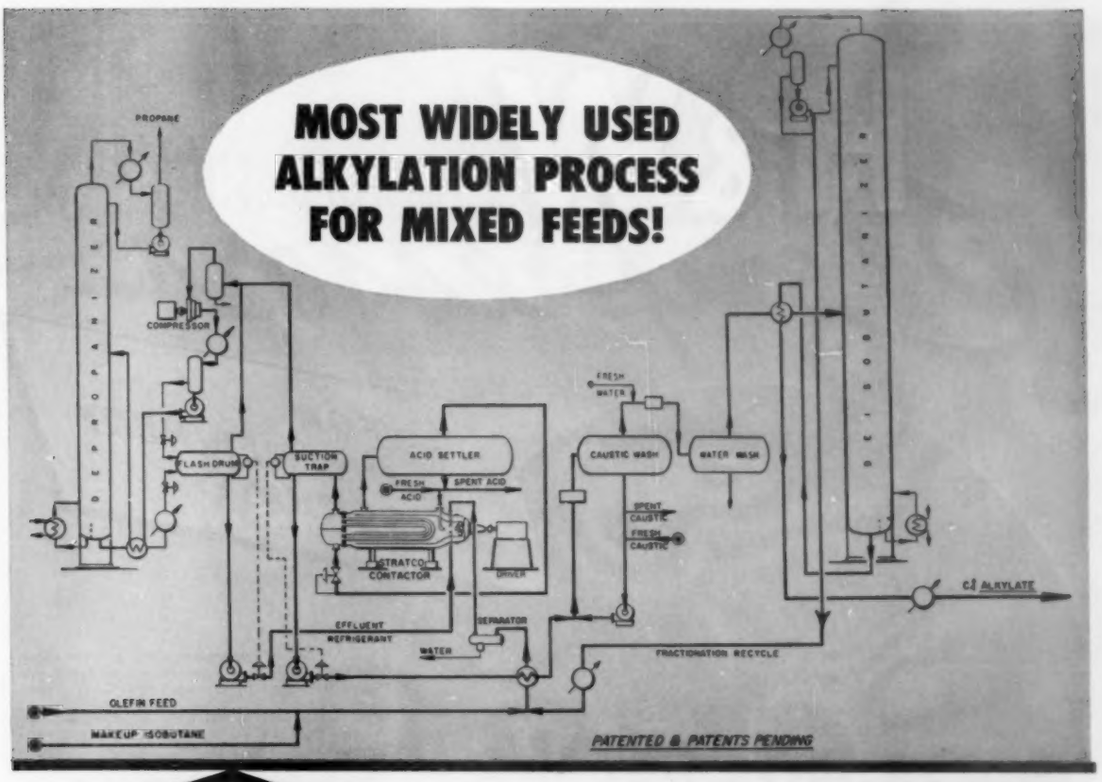

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H & W - COOPER-BESSEMER *Compressors*

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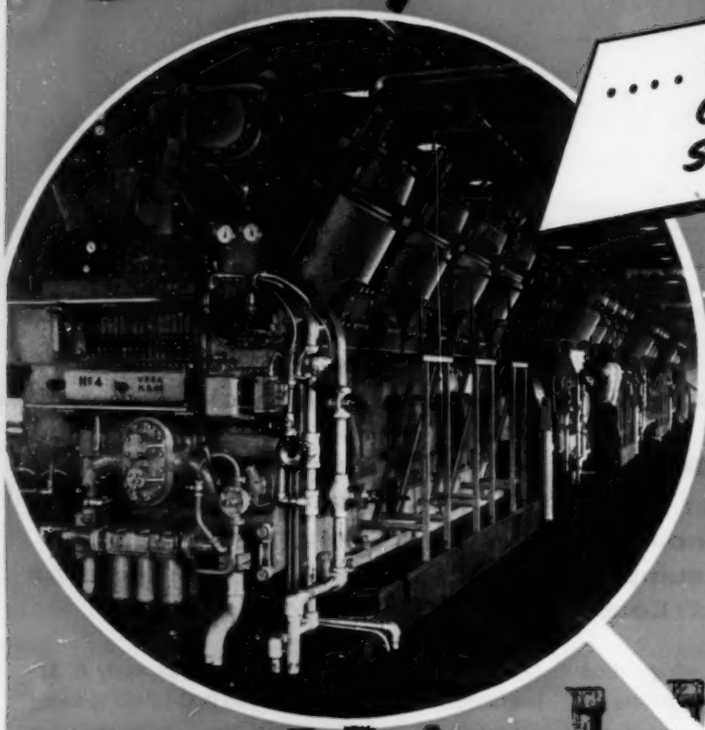

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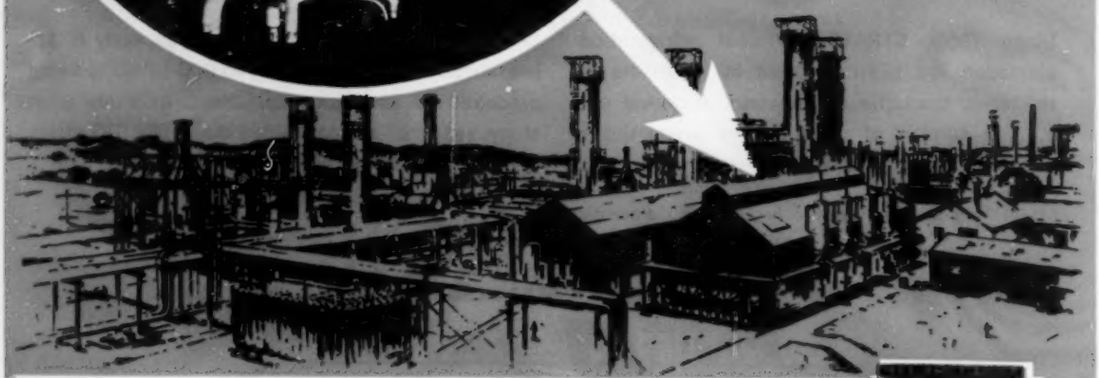

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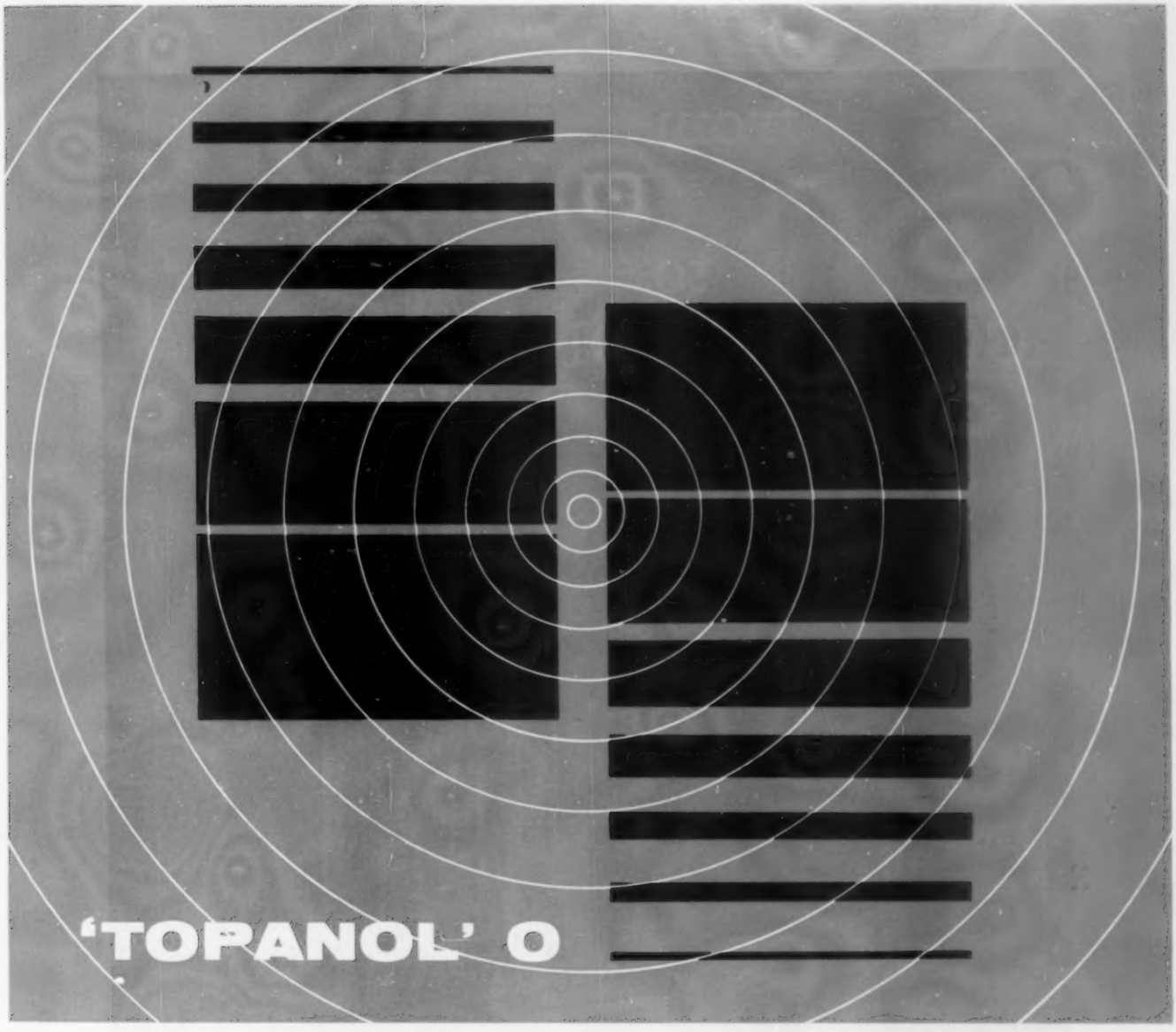

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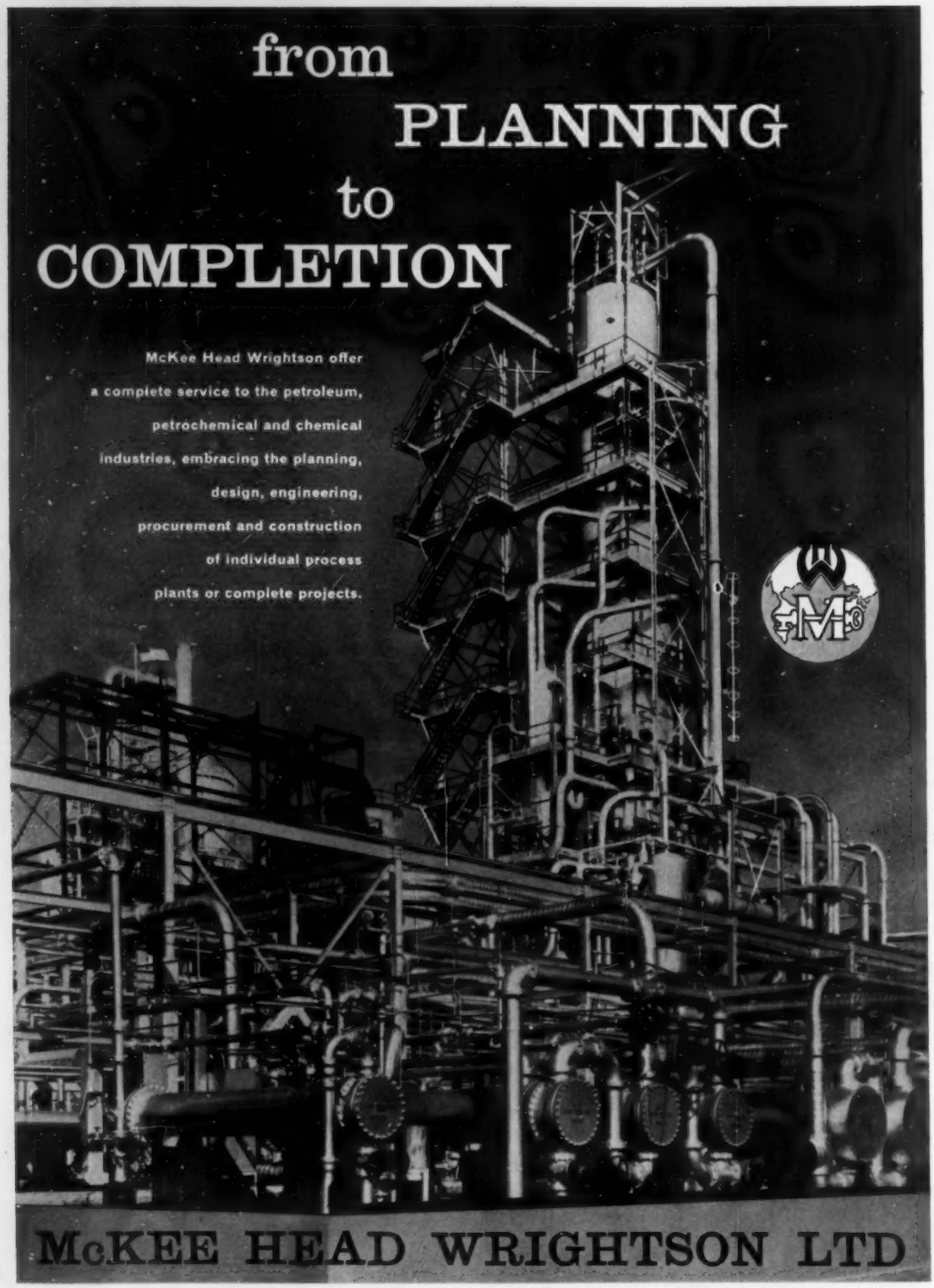

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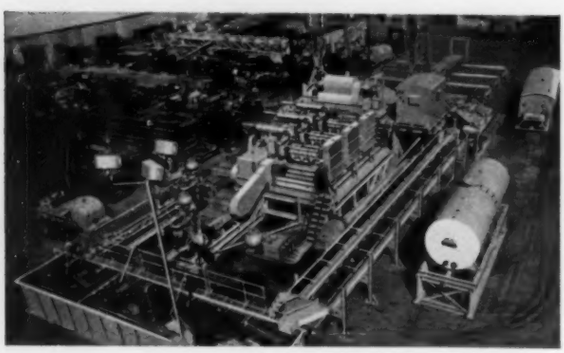

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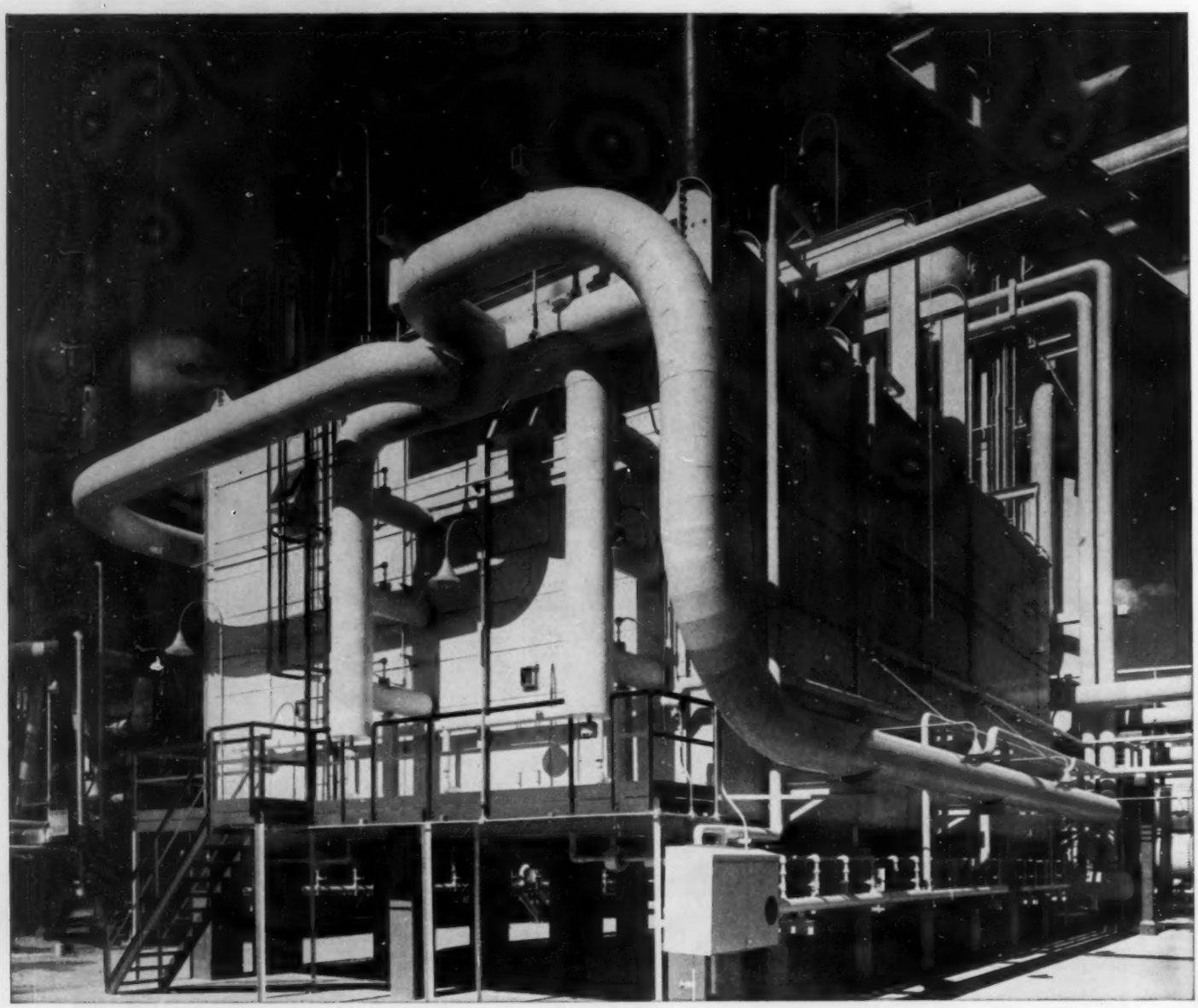

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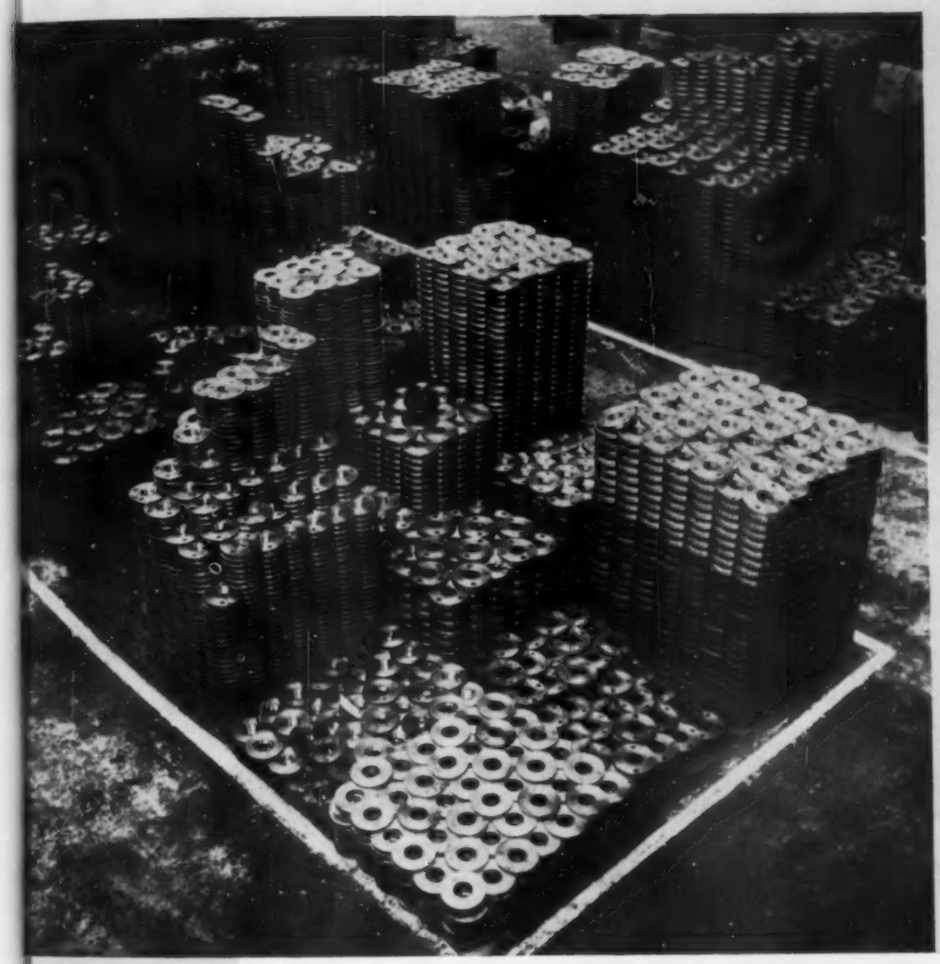

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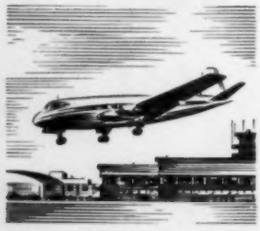

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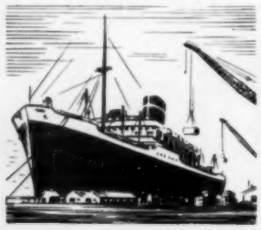
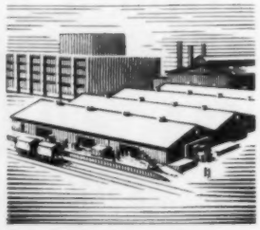


SHIPPING *As well as protecting ships of the Royal Navy, Pyrene Fire Protection Systems safeguard passenger and cargo ships, tankers, tugs, docks and harbours throughout the world.*



INDUSTRY *In factories of all kinds—in processing plants—in office blocks, shops and stores Pyrene Fire Appliances and installations safeguard against every fire risk with the world's widest range of equipment.*

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"Pyrene" fire safety developments

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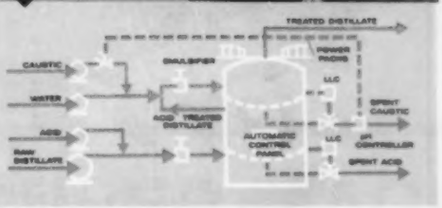
gives refiners *better quality*

One type of ELECTRO-FINING Precipitator installation.

ELECTROFINING Precipitator flow diagram for typical acid-caustic treating.



Refiners everywhere have found that they can depend on ELECTROFINING* Precipitators and the BENDER Catalytic Sweetening Process to meet the ever-growing demand for higher quality. These versatile units—designed, installed, and operated according to Petreco specifications to meet various purification problems—provide important *extra* refining steps that improve a wide variety of petroleum products.

Petreco ELECTROFINING Precipitators purify various distillates, from light naphthas to lubricating oils, through the combined use of appropriate chemical reagents and the coalescing forces of an electric field. An ELECTROFINING Precipitator installation occupies less ground space—and requires fewer pumps, pipes, and vessels—than any other treating system providing comparable results. Operation is automatically controlled to assure maximum purification and trouble-free performance.

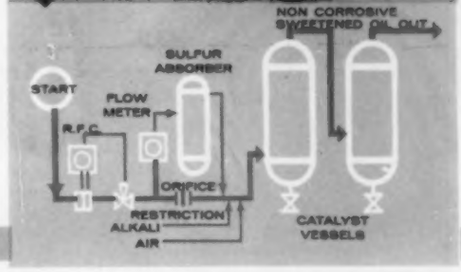
BENDER Catalytic Sweetening units effectively treat middle-range distillates by converting mercaptans to disulfides through oxidation. This process (using PETRECO* Catalyst) is simple, continuous, and automatic, with no product loss or air pollution. Compact BENDER units can be installed and operated at substantial savings in capital outlay and operating expenses, as compared with conventional sweetening methods. Treated distillates are fully able to meet doctor and corrosion tests.

Petrolite also offers other processes and chemicals for use throughout the petroleum industry. These include PETRECO* Desalting, Dehydration, Desaponification, and Sediment Separation, as well as TRET-O-LITE* Demulsifiers and Desalting Chemicals, KONTOL* Corrosion Inhibitors, SOLVO* Paraffin Removers, FLUDEX* Water Flood Additives, and S. P.* Scale Preventives. The Petrolite research and development staff will welcome an opportunity to determine the proper treating required for your particular needs. Contact your nearest Petrolite engineer. He is available for service, inspection, and advisory assistance—anywhere in the world.

* *Registered trademark, Petrolite Corporation*

BENDER sweetening installation comprised of two sulphur absorbers and catalyst vessels.

BENDER Catalytic Sweetening Process flow diagram.



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Montreal, Quebec	1,000 BPD
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Concon	1,100 BPD
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Abadan	6,000 BPD
SAUDI ARABIA	
Ras Tanura	1,400 BPD
UNITED STATES	
East Chicago, Ind.	2,600 BPD
Beaumont, Texas	5,000 BPD
Texas City, Texas	3,500 BPD
Whiting, Ind.	5,000 BPD
Lake Charles, La.	12,750 BPD
Lake Charles, La.	20,675 BPD

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Salt Lake City, Utah	3,000 BPD
Toledo, Ohio	3,500 BPD
Lake Charles, La.	3,000 BPD
West Tulsa, Okla.	2,500 BPD
Perth Amboy, N.J.	3,500 BPD
El Paso, Texas	1,000 BPD
Nederland, Texas	4,150 BPD
Dumas, Texas	4,000 BPD
Houston, Texas	9,400 BPD
Philadelphia, Pa.	4,000 BPD
Toledo, Ohio	1,000 BPD
Casper, Wyo.	800 BPD
Tyler, Texas	3,000 BPD
E. Chicago, Ind.	4,300 BPD
Delaware City, Del.	9,000 BPD
Port Arthur, Texas	7,200 BPD
Buffalo, N.Y.	2,400 BPD
Toledo, Ohio	2,000 BPD
Eldorado, Ark.	2,400 BPD
Cleveland, Ohio	3,500 BPD
Warren, Pa.	1,100 BPD*
Robinson, Ill.	2,000 BPD
Toledo, Ohio	3,500 BPD

*Future

FOR REFINERS wishing to increase their barrel octane for the lowest optimum over-all expenditure, Kellogg can design and build an alkylation unit which will utilize normal refinery feeds, yield the desired quantity and quality of alkylate, yet cost less to install and operate than ever before.

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The most efficient, most economical, and most flexible of these alkylation units are those utilizing Kellogg's most recent sulfuric acid, multi-stage cascade reactor design. Whether for 500 or 15,000 BPD, Kellogg can undertake the entire design, procurement, and construction of one of these units for a lump-sum contract.

Designed to operate on butylene, propylene, amylenes, or a combination feed, these new units offer many advantages over other models. They can produce an LPG product, as well as high octane alkylate, without supplementary towers or equipment. They reduce corrosion to a minimum without extensive use of expensive chemicals. They are extremely low on acid consumption—using, for example, less than 0.3 sulfuric acid per gallon of alkylate. They are adaptable to seasonal demands—capable of maintaining peak barrel octane production at minimum operating cost.

Kellogg welcomes the opportunity to discuss the details of its alkylation process with you.

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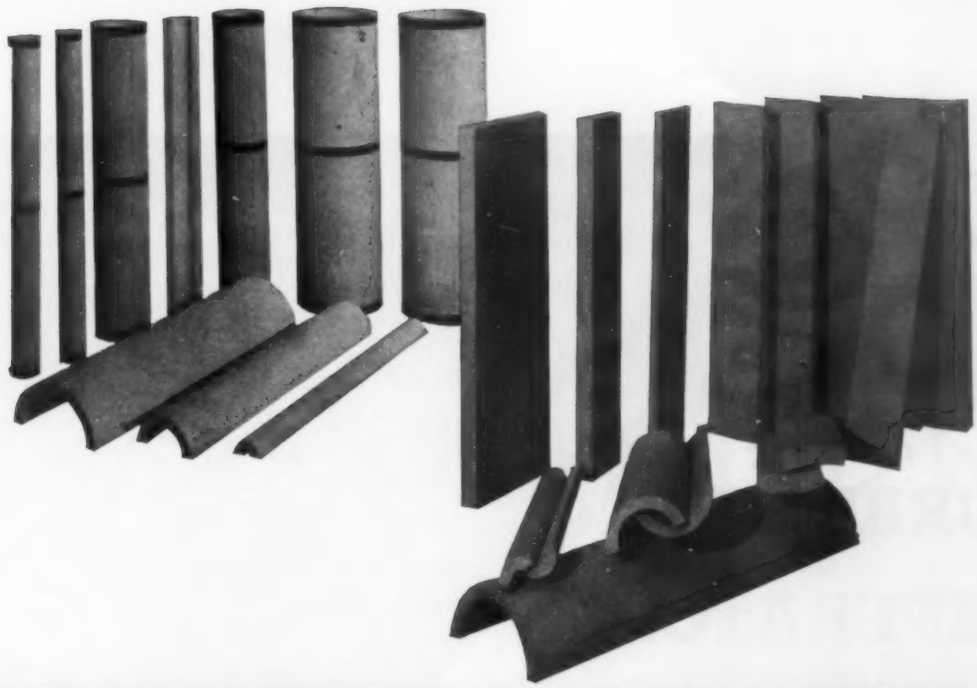

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a *new* exclusive insulating product it resists water, weather and all hard wear and tear

Darlington precision-moulded 85% Super-magnesia is a new and improved form of 85% Magnesia insulation possessing many superior physical characteristics. In particular, its form and efficiency are unimpaired by steam, water or adverse weather conditions; also it has a very high compressive strength with good rigidity which enables it to withstand all mechanical shock and wear and tear. Costing no more than ordinary 85% Magnesia material, Darlington Super-magnesia is a product *exclusive* to The Chemical & Insulating Co. Ltd.

Here are some of the special features of 'Supermag'

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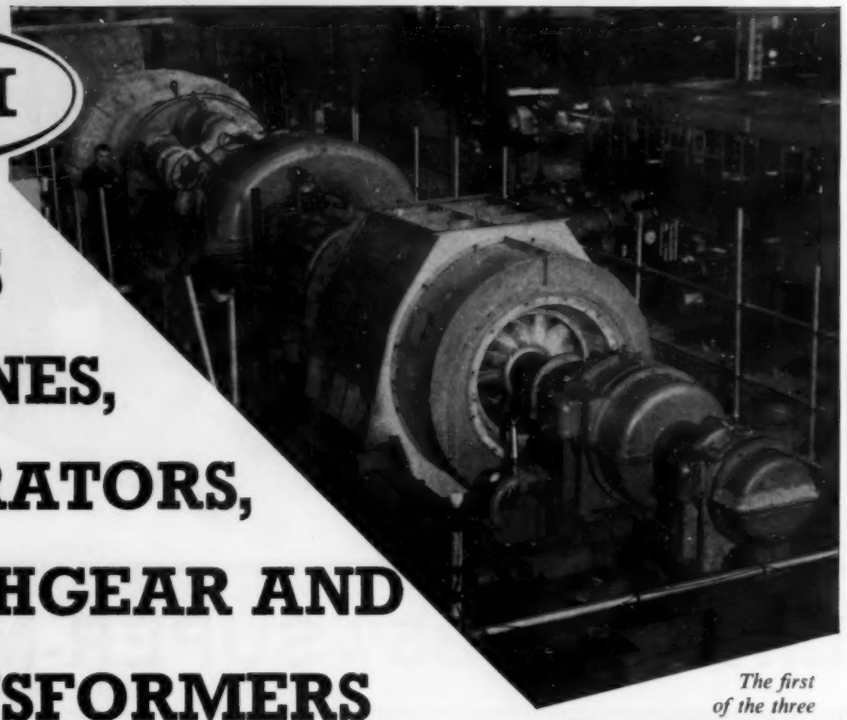

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ARE BEING SUPPLIED FOR THE

GACH SARAN POWER SYSTEM

Full advantage of the plentiful supply of natural gas from the Gach Saran area will be taken by the Iranian Oil Exploration and Producing Co. Ltd., when the three AEI L51C-gas turbine-generators are installed.

If necessary, these units—which only require simple foundations—can be started and controlled by one operator, and brought from rest to full load in a very few minutes.

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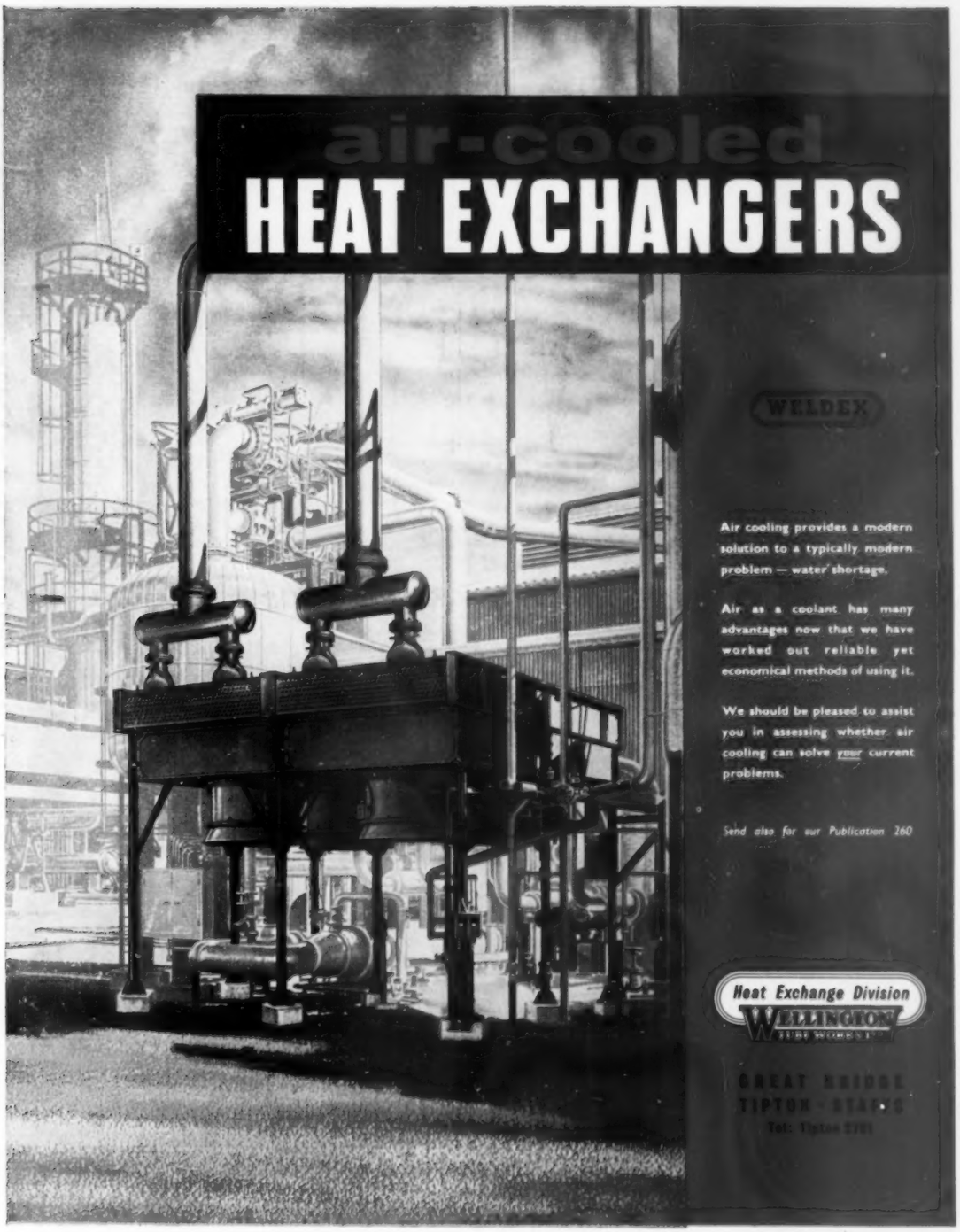
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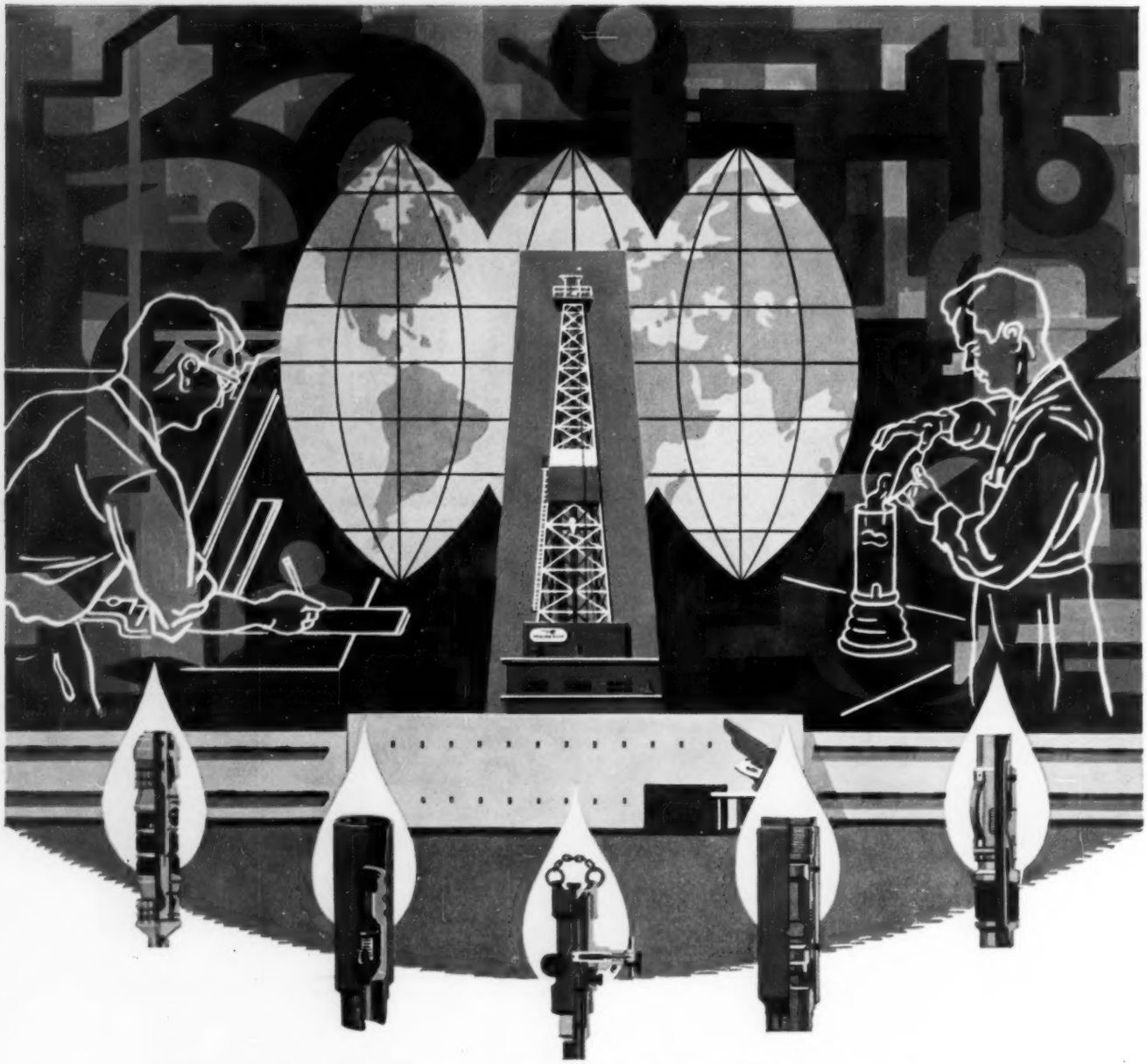

The Well that Must Not Produce

Sounds ridiculous we know, but we hope Halliburton Experimental Well No. 5 never makes one drop of oil . . . because this well is a part of our research and pretesting of the tools, equipment, and techniques that you constantly are asking for.

The biggest benefits that come from this *Well that Must Not Produce,* is the knowledge that helps determine the practicability of the things we provide, as part of our ever expanding world-wide service operation.

We don't experiment, except at home, and when our experimental well tells us we are on the right track, we can then offer you a bigger, sounder benefit than we could, if we didn't have "The Well that Must Not Produce."

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WHO *IS* RESPONSIBLE?

At the recent meeting of the American Petroleum Institute's Division of Accounting the keynote speaker was Albert L. Nickerson, president of Socony Mobil Oil Co., Inc. His thesis was that emphasis in the industry has shifted from supplying adequate quantities of oil products to that of efficient operations. Speaking to the industry's comptrollers, the professional gatherers of data for management, he entered a plea for predigested information which can be assimilated quickly; for timely figures even though some approximations are necessary; and for what he called "Responsibility Accounting."

"If all the information which comes to management is expressed in terms that match up with the individual lines and areas of responsibility in the organization, the information is just that much more useful," Mr. Nickerson said. "The reason is obvious. The manager can turn immediately to the responsible person to find out what can be done to improve the situation, or whom to reward for the good picture he sees.

"If operating managers are to be judged, it is necessary first to know what parts of their total performance are subject to their discretion and control, and second, what parts are outside their control and the result of the environment in which they are operating. To evaluate a man's handling of controllable expenses correctly and equitably, we need to select sound standards for the measurement of his performance. To accomplish this, the standards must be selected in cooperation with the management that is going to do the judging and the managers who are to be judged. Otherwise, either the information on performance will be misleading to top management, or will antagonize the operating manager—or both."

In the discussion which ensued the comptrollers took a clear-eyed view of cost reduction particularly in the manufacturing division of the industry. A good deal was said about the fallacy of the low cost incremental barrel. They showed that the ultimate effect of reducing refining costs by a tenth of a cent per gallon through capacity operations may have the final result of a drop of a half cent per gallon in the selling price of the product in the competitive market place.

Mr. Nickerson obviously went to the heart of the matter when he raised the question of responsibility for cutting costs. The refinery manager can exert some control over his operating costs by effective use of manpower, by preventive maintenance procedures to avoid a costly shut-down between scheduled turn-arounds, by reconditioning of equipment and by careful husbanding of expendables such as chemicals and other supplies. These clearly are his responsibility and he can and should be judged on his performance in these areas.

When it comes to a reduction of unit costs through maximum throughput the refinery manager should not be responsible. He should not determine his throughput with unit costs in mind. Every refinery manager who is judged by his superiors on the unit cost basis will naturally run at top speed to show the lowest possible figure. The producer will do the same subject only to MER in areas where he is not under state proration.

Mr. Nickerson also made a cogent remark when he told the comptrollers that figures should be timely. If sales lag and bulk plant stocks shoot upward it is too late to know about this sixty or ninety days later when it becomes necessary for refinery and pipeline deliveries to be cut back. The last decimal point is not required but the picture must be made available on a daily or at least weekly basis.

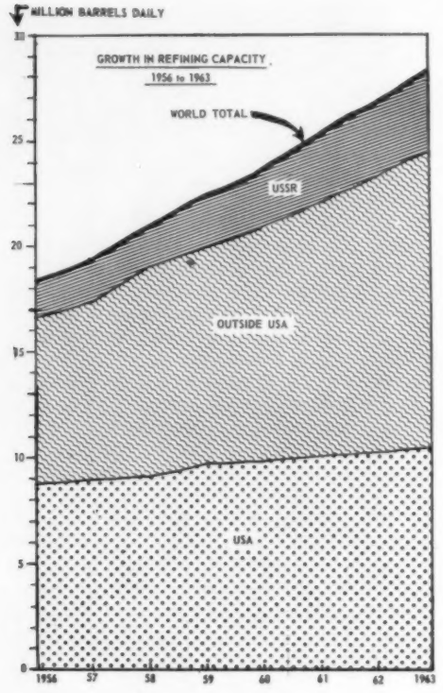
Hughes Tool Co. recently spent a million dollars to install electronic equipment for the control of bit inventories. Manufacturing bits is a very complex process requiring hundreds of inspections for quality and many operations. Six weeks elapses from raw steel to finished bit. To prevent maladjustment of product mix and unwieldy inventory, Hughes gathers sales, warehouse and factory figures daily and through automated equipment gives management all the data needed to provide adequate stocks of all sizes of bits—but not too many. A bit valued at $1,000 to $1,500 is much more costly than a barrel of gasoline, but not so many are made and the impact on company profits is the same. Hughes control starts at the well and goes clear back to the billet of raw steel.

Oil industry control likewise should start at the gasoline pump or the fuel oil tank wagon and go back to the oil well. Only thus can inventories cease to become burdensome and cause disastrous price reductions.

"Responsibility Accounting" as suggested by Mr. Nickerson will segregate costs which are the responsibility of the producing superintendent and the refinery manager from those which are the responsibility of company policy makers—the men in the front office who should know in what volume the product is flowing to the consumer and who should regulate the movement of raw materials from the well to the bulk plant accordingly.

Top management *is* responsible for the health of the company and of the industry.

World processing continues rise



Refining capacity will increase 20.8% by 1963, with the Eastern Hemisphere dominating the growth pattern. Announced refinery and petrochemical construction represents capital expenditures of about $6.5 billion

by William C. Uhl
Processing Editor

THE WORLD'S TOTAL refining capacity, at 23.43 million b/d this year, will rise 20.8% by 1963, to 28.30 million b/d.

Construction in the Eastern Hemisphere continues to account for a major portion of the increase. Studies by WORLD PETROLEUM indicate an expansion of almost 29% in comparison with about 11% in the Western Hemisphere. Expansion in the Western Hemisphere will be some 1,525,700 b/d, from a 1960 level of 13,727,700 b/d to an estimated 1963 level of 15,253,400 b/d. In the east, capacity will rise from 7,050,400 b/d this year to 9,089,100 b/d in 1963, an increase of 2,028,700 b/d.

Eastern Hemisphere totals exclude USSR and other Communist nations, on which available statistical data are somewhat less reliable. These nations expect to increase about 50%, from 2,648,000 b/d to 3,957,000 b/d.

The trends and shifts in the world refining industry are summarized in the accompanying tables. Table 1 covers trends in capacity. Table 2 shows where expansion is taking place and the estimated investment in the new construction projects. Table 3 is an overall analysis of planned investment—both conventional refining and petrochemicals—for the non-Communist world, for the periods 1958-1962 and 1963-1967. Table 4 summarizes the trends in growth for three major downstream processes. The large Table 6 (on the following pages) presents the data shown in more detail further on in this issue for all the world's refineries presently in operation, planned or under construction, in countries outside the USA.

Expenditures of $3.5 billion for refining expansion are shown for those projects on which companies have released information (Table 2). On the basis of these estimates, as well as on the basis of the long-range forecasts shown in Table 3, it is reasonable to forecast a total investment in the non-Communist world for new refining capacity and new or expanded downstream processing of nearly $7 billion in the next few years.

The most spectacular percentage increase in capacity is expected in Africa, 124%; however, the base is considerably lower than in other geographical areas. In Western Europe, a very healthy 26.3% increase is planned—about 1,088,200 b/d—from 4,146,700 b/d to 5,234,900 b/d. In Asia and the Far East, the rise will be 540,000 b/d (38.1%), from 1,413,300 b/d to 1,953,300 b/d. In the Western Hemisphere, the dominant percentage increase is in South America, 23.1%, for a volume increase of 609,200 b/d. See Tables 2 and 6.

Substantial gains in capacity will take place in eight countries, as indicated in Table 6. Argentina will add 83,700 b/d (30%); Brazil, 155,700 b/d (86%); Belgium, 90,000 b/d (61%); France, 140,000 b/d (16.7%); West Germany, 312,500 b/d (52%); Italy, 203,000 b/d (26%); Netherlands, 146,000 b/d (40%); and Japan, 223,000 b/d (36%).

A total of 23 countries will install their first refineries during the next year or two, accounting for 28 new plants and a total capacity of close to half a million daily barrels. Seven of these are in the Western Hemisphere: Guatemala, 15,500 (two refineries); Honduras, 15,000 b/d (two refineries); Jamaica, 7,500 b/d; Nicaragua, 10,000 b/d; Panama, 115,000 b/d (two refineries); El Salvador, capacity not announced; and Paraguay, 10,000 b/d.

The Eastern Hemisphere nations, and capacities in b/d, are as follows: Algeria, 44,000; Kenya, 36,000; Libya, 4,000; Mozambique, 13,000; Tunisia, 20,000; Jordan, 6,600; Ceylon, 22,000; Korea (South), 15,000; New Zealand, 40,000; Switzerland, 40,000; Singapore, 40,000 (two refineries). No capacities were announced for new plants in the following countries; Ethiopia, Nigeria, Sudan, Malaya, and Vietnam. The Ethiopian plant is to be built by Russia.

The major trend in downstream processing world-wide is in catalytic reforming, which will rise 362,300 b/d by 1963, 13.2% over the installed and operating capacity level of this year. Hydrogen processing will increase some 291,500 b/d, or almost 11% over this year's level. There will still be some new catalytic cracking built—217,300 b/d—for a 4.3% rise over today's capacities. See Table 4. In the field of petrochemicals it is not possible to develop clear-cut data on world-wide growth in throughput as can be done in refining. Although virtually all companies make known the major products and the locations of their manufacturing facilities, only about one-third of the announcements on new proj-

Table 1—World Trends in Refining Capacity, 1956-1963
(in million barrels daily)

	USA	Outside USA	Free World Total	USSR	World Total
1956	8.72	7.94	16.66	1.54	18.20
1957	8.92	8.51	17.43	1.80	19.23
1958	9.19	9.93	19.02	1.95	20.97
1959	9.80	10.08	19.88	2.40	22.28
1960 est.	9.74	11.04	20.78	2.65	23.43
1963 est.	10.50	13.84	24.34	3.96	28.30

Table 2—World Refining Expansion, 1960-1963

	Current projects		Increase in crude capac.		Estimated investment[1]
	New plants	Expansions	1000 b/d	% age	$ millions
North America	4[2]	5[2]	916.5	7.9	935[3]
South America	16	12	609.2	23.0	598
West. Hemisphere	20	17	1,525.7	11.1	1,533
Western Europe	22	8	1,088.2	26.3	1,012
Africa	9	4	146.0	124.0	265
Middle East	6	5	154.5	11.2	158
Asia & Far East	20	7	540.0	38.1	614
East. Hemisphere	57	24	2,028.7	28.8	2,049
Total World[4]	77	41	3,554.4	17.1	3,582

[1] Based on total announced projects only. Investment figures were reported by companies for 47 out of total 118 projects; balance were estimated on basis of current costs. For longer range forecasts see Table 3.
[2] Does not include current USA projects.
[3] Includes estimated current USA plans for expenditures.
[4] Does not include USSR and Communist countries.

Table 3—World Processing Plant Investments, 1958-1967
(in $ millions)

	1958-1962	1963-1967	1958-1967
United States	5,000	6,250	11,250
Other Free World	6,125	7,500	13,625
Totals	11,125	13,750	24,875

Source: World Petroleum Report—1959, p. 25. Includes both refining and petrochemicals.

Table 4—World Trends in Major Refining Processes, 1960-1963
(capacities in 1000 b/d)

	Catalytic cracking vol. inc.	%	Catalytic reforming vol. inc.	%	Hydro. proc'g. (desulfuriz.) vol. inc.	%
North America	152.0	3.8	192.3	9.3	183.9	8.6
South America	20.0	4.4	18.2	24.2	20.0	18.7
West. Hemisphere	172.0	4.0	210.5	9.8	203.9	9.1
Western Europe	10.0	2.1	40.4	8.9	10.0	2.7
Africa, M.E., Asia and Far East	34.3	12.6	111.4	80.0	77.6	60.2
East. Hemisphere	45.3	6.2	151.8	25.5	87.6	17.3
World Totals	217.3	4.3	362.3	13.2	291.5	10.6

ects include information on output volume and/or planned expenditures. Studies of information gathered by World Petroleum are summarized in Table 5. Detailed listings of individual petrochemical plants are further back in this issue.

There are today approximately 584 operating petrochemical plants throughout the non-Communist world, the majority of them being in the USA. Completely new plants now planned or under construction amount to 162, and there are 74 expansions planned or underway.

Total investment indicated for the reported petrochemical projects is a little over $3 billion. However, based on current investment costs and the long-range plans shown in Table 3, it is reasonable to forecast a total world-wide expenditure during the next few years of between $4 and $4.5 billion.

A number of interesting trends in the types of petrochemical products manufactured have been found in the World Petroleum survey, even though statistical details are difficult to develop.

1. A considerable growth in new production facilities for ammonia and synthetic fertilizers derived from ammonia, in South America, Spain, Pakistan, and India.

2. Some increase in carbon black plants, especially in France and Italy.

3. A very solid increase in sulfur, particularly in Canada as a result of the approval of natural gas export which is bringing a boom in construction of plans in the western provinces to remove sulfur from very sour gas (see also World Petroleum, May, 1960, pp. 76 and 84).

4. Substantial growth in polyolefin manufacture, more particularly polyethylene, in France, Germany, Italy, United Kingdom, Australia, and Japan.

5. A beginning trend toward another polyolefin—polypropylene—as a result of the rapid progress in process technology and scientific work in organo-metallic chemistry.

6. A substantial increase in capacity for aromatics in Japan.

7. The start of a number of phthalic and maleic anhydride plants in Canada, Argentina, Belgium, Italy, United Kingdom, and Japan.

8. A sizable increase in production capacity for GRS synthetic rubber (styrene-butadiene copolymer), with the following increases (in thousand metric tons annually) reported in six countries: Argentina, 40; France, 50; United Kingdom, 34; Australia, 30; Mexico and Netherlands, volumes not announced.

9. Full-scale commercial production facilities to be constructed for two other rubber type materials—polyisobutylene and polybutadiene—in France, Germany, and United Kingdom.

The annual growth rate in petrochemicals far exceeds that for conventional refining. Authoritative estimates indicate that USA petrochemicals will rise at about 9% per year during the next five years, and estimates for outside the USA are almost double that, ranging from 12 to 19% per year.

Output of petrochemicals in the USA today is more than 22 million metric ton/yr, according to David A. Shepard, executive vice president and director of Standard Oil Co. (New Jersey), in an address last month before the Société de Chemie Industrielle in Paris. He said petrochemicals constitute 30% by volume of all USA chemicals, and this is expected to increase to 40% by 1965, to a level of 40 million ton/yr. Of even greater interest, Mr. Shepard pointed out, is the fact that petrochemicals currently represent 57% of the dollar value of all chemicals manufactured in the United States.

Table 5—Current World Petrochemicals Plant Construction

Country	Plants	New plants	Expansions	Invest.[1] $ millions
Canada	35	15	6	98.6 (12)
Mexico	4	3	2	N.A.
USA	400[2]	42[2]	21[2]	1,842.0[3]
North America	439	60	29	1,940.0
Argentina	2	9	1	64.0 (2)
Brazil	16	4	1	6.0 (1)
Chile	1	0	0	0
Colombia	1	1	0	13.0
Costa Rica	0	1	0	10.0
Peru	1	0	0	0
Puerto Rico	1	0	0	N.A.
Trinidad	0	1	0	N.A.
Uruguay	0	1	0	N.A.
Venezuela	0	2	0	2.4 (1)
South America	21	21	2	95.4 (6)
Austria	1	2	0	N.A.
Belgium	1	6	0	2.0 (1)
France	31	11	9	5.0 (1)
Germany (West)	20	5	8	5.0 (1)
Greece	0	2	0	1.0 (1)
Italy	16	14	4	105.0 (4)
Netherlands	2	7	0	4.5 (2)
Portugal	1	0	0	0
Spain	0	4	0	71.0 (2)
United Kingdom	27	4	11	325.5 (5)
Europe	99	55	32	519.0 (15)
Algeria	0	1	0	N.A.
Iran	0	1	0	N.A.
Israel	0	1	0	6.0
Australia	5	8	3	105.5 (8)
India	2	5	0	102.0 (2)
Indonesia	0	1	0	30.0
Japan	17	4	8	79.1 (10)
Korea	0	1	0	33.5
Malaya	0	1	0	N.A.
Pakistan	0	3	0	20.0 (1)
South Africa	1	2	0	N.A.
Africa, M.E., Asia, and Far East	25	26	11	376.1 (21)
World Totals	584	162	74	3,028.1[4]

[1] Planned expenditures shown are based only on announced projects where official investment has been given. Numbers in parentheses indicate the number of projects on which investment figures were given.
[2] Based on current published information on USA petrochemical industry.
[3] Estimate made by D. A. Shepard, Standard Oil Co. (N.J.) at Société de Chemie Industrielle, Paris, France, June 8, 1960.
[4] Estimated world total planned expenditures shown here is based only on announced projects in which information was made public. Actual total is probably closer to $4 billion or $4.5 billion.

TABLE 6—WORLD PETROLEUM REFINERIES

Summary of crude and major processing capacities for 1960, with estimates for 1963

(Figures in thousand barrels daily)

Country	Year	No. of Plants	Crude Capacity	Vacuum Distillation	Thermal[1] Operations	Catalytic Cracking	Catalytic Reforming	Desulfuriz.	Polymer.	Alkylation
Canada	1960	42	945.1	340.0	146.9	287.2	158.1	162.0	17.0	13.6
	1963	45	976.1	340.0	149.9	287.2	165.4	176.9	17.0	22.0
Mexico	1960	8	399.0	74.0	43.5	60.0	15.0	58.0	4.2	3.0
	1963	8	519.0	74.0	43.5	75.0	15.0	58.0	4.2	3.0
U. S. A.[2]	1960	293	9,735.0	3,258.0	2,010.0	3,639.0	1,905.0	1,934.4	145.5	409.5
	1963	293	10,500.0	3,300.0	2,010.0	3,750.0	2,100.0	2,100.0	150.0	475.0
Total North America	1960	343	11,079.1	3,672.0	2,200.4	3,960.2	2,078.1	2,151.0	166.7	422.3
	1963	346	11,995.6	3,714.0	2,203.4	4,112.2	2,270.4	2,334.9	171.2	500.0
Barbados	1960	1	1.0							
	1963	1	1.0							
Cuba	1960	8	86.6	22.1	0.6	14.6	11.2	6.5	1.0	
	1963	9	104.6	22.1	0.6	14.6	11.2	6.5	1.0	
Guatemala	1960	0	0							
	1963	2	15.5							
Honduras	1960	0	0							
	1963	2	15.0							
Jamaica	1960	0	0							
	1963	1	7.5							
Netherlands Antilles	1960	2	650.0	19.2	418.0	80.0				11.2
	1963	2	650.0	19.2	418.0	80.0				11.2
Nicaragua	1960	0	0							
	1963	1	10.0							
Panama	1960	0	0							
	1963	2	115.0							
Puerto Rico	1960	2	90.0	58.7	20.0	62.1	7.5	10.0	5.7	1.4
	1963	2	90.0	58.7	20.0	62.1	7.5	10.0	5.7	1.4
El Salvador	1960	0	0							
	1963	1	N.A.							
Trinidad	1960	3	192.0	60.0	25.0	28.0	8.5	8.5	1.3	2.2
	1963	3	304.0	60.0	25.0	28.0	23.5	28.5	1.3	2.2
Total Central America and Caribbean	1960	16	1,019.6	160.0	463.6	184.7	27.2	83.5	8.0	14.8
	1963	26	1,312.6	160.0	463.6	184 7	42.2	103.5	8.0	14.8
Argentina	1960	16	279.6	16.2	108.1+	32.0	0		3.3	5.5
	1963	17	363.3	16.2	126.6+	48.6	3.2		3.3	5.5
Bolivia	1960	4	11.9							
	1963	4	11.9							
Brazil	1960	8	180.8	20.5	31.0+	49.0	11.0		3.5	
	1963	10	336.3	20.5	31.0+	49.0+	11.0+		3.5	
Chile	1960	3	47.2		14.0	12.0	6.0	6.0		1.1
	1963	3	47.2		14.0	12.0	6.0	6.0		1.1
Colombia	1960	5	71.4	18.0	16.5	28.1			3.6	1.2
	1963	5	71.4	18.0	16.5	28.1			3.6	1.2
Ecuador	1960	3	16.0	0.3	6.6					
	1963	3	24.0	0.3	6.6					
Paraguay	1960	0	0							
	1963	1	10.0							
Peru	1960	3	47.6		14.7					
	1963	5	47.6+		14.7					
Uruguay	1960	1	42.0		2.2	1.5	3.0			
	1963	1	56.0		2.2	5.0	3.0			
Venezuela	1960	11	932.5	99.0	105.2	44.7	27.7	17.0	2.0	2.5
	1963	12	977.5	99.0	105.2	44.7	27.7	17.0	2.0	2.5
Total South America	1960	54	1,629.0	154.0	298.3	167.3	47.7	23.0	12.4	10.3
	1963	61	1,945.2	154.0	316.8	187.4	50.9	23.0	12.4	10.3
Total Western Hemisphere	1960	413	13,727.7	3,986.0	2,962.3	4,312.2	2,153.0	2,257.5	187.1	447.4
	1963	432	15,253.4	4,028.0	2,983.8	4,584.3	2,363.5	2,461.4	191.6	525.1
Austria	1960	6	31.8	2.2	5.3	0	0			
	1963	6	64.4	2.2	5.3	N.A.	N.A.			
Belgium	1960	7	165.2	20.0	13.4	26.1	20.5	20.7	3.6	
	1963	7	255.2	20.0	13.4	26.1+	20.5+	20.7+	3.6	
Denmark	1960	3	0.6		3.3		0	0		
	1963	4	20.6		3.3		N.A.	N.A.		
Finland	1960	2	42.2	12.0		14.3	6.8		3.8	
	1963	2	42.2	12.0		14.3	6.8		3.8	
France	1960	15	831.7		90.7+	105.5	102.7	49.5	3.9	2.0
	1963	18	971.7		90.7+	105.5	102.7+	49.5+	3.9	2.0
Germany (West)	1960	23	601.5	30.1	31.3	64.7	82.9	103.8	5.1	
	1963	32	914.0+	47.6+	31.3	74.7+	116.9+	103.8+	5.1	
Greece	1960	3	67.0	2.4			15.4			
	1963	3	73.0	2.4			15.4			
Ireland	1960	1	41.7				9.0	6.1		
	1963	1	41.7				9.0	6.1		
Italy	1960	39	780.5	32.0	79.4	45.8	79.0	68.3	6.6	
	1963	43	983.0	32.0+	79.4	45.8	85.4	78.3	6.6	
Netherlands	1960	2	359.0	36.0	46.5	77.0	20.2	33.8	7.7	2.5
	1963	3	**495.0**	36.0	46.5	77.0	20.2+	33.8+	7.7	2.5
Norway	1960	1	2.3				0	0		
	1963	3	82.3				N.A.	N.A.		
Portugal	1960	1	21.6			9.5			1.3	
	1963	1	27.0			9.5			1.3	
Spain	1960	3	140.7	3.2	11.5		16.0		1.6	
	1963	3	162.7	3.2	11.5		16.0		1.6	
Sweden	1960	5	63.6	8.3	5.9		11.8	7.2		
	1963	5	64.8	8.3	5.9		11.8	7.2		
Switzerland	1960	0	0							
	1963	1	40.0							
United Kingdom	1960	16	997.3	94.2	54.9	125.4	90.8	85.1	8.5	2.2
	1963	16	997.3	94.2	54.9	125.4	90.8	85.1	8.5	2.2
Total Western Europe	1960	127	4,146.7	240.4	342.2	468.3	455.1	374.5	42.1	6.7
	1963	148	5,234.9	257.9	342.2	478.3+	495.5+	384.5+	42.1	6.7
Algeria	1960	0	0							
	1963	1	44.0							
Angola	1960	1	3.0							
	1963	1	3.0							
Egypt	1960	3	85.0	7.7	12.8		0.8	5.6	0.5	
	1963	3	127.0	7.7	12.8		6.1	8.3	0.5	

Country	Year	No. of Plants	Crude Capacity	Vacuum Distillation	Thermal[1] Operations	Catalytic Cracking	Catalytic Reforming	Desulfuriz.	Polymer.	Alkylation
Ethiopia	1960	0	0							
	1963	1	N.A.							
Kenya	1960	0	0							
	1963	1	36.0							
Libya	1960	0	0							
	1963	1	4.0							
Morocco	1960	1	2.4			3.5	0	0		
	1963	2	27.4			3.5	4.6	4.6		
Mozambique	1960	0	0				0	0		
	1963	1	13.0				2.5	2.5		
Nigeria	1960	0	0							
	1963	1	N.A.							
South Africa	1960	2	27.5	2.0	3.1	10.0	5.0	6.0	0.3	
	1963	3	89.5	2.0	3.1	10.0+	5.0+	6.0+	0.3	
Sudan	1960	0	0							
	1963	2	N.A.							
Tunisia	1960	0	0							
	1963	1	20.0							
Total Africa	1960	7	117.9	9.7	15.9	13.5	5.8	11.6	0.8	
	1963	18	363.9+	9.7	15.9	13.5+	18.2+	21.4+	0.8	
Aden	1960	1	120.0				12.0	3.5		
	1963	1	120.0				12.0	3.5		
Bahrain	1960	1	186.5	34.0	28.0	27.3	10.5	10.5	2.1	
	1963	1	186.5	34.0	28.0	27.3	10.5	10.5	2.1	
Iran	1960	4	437.6	74.0	81.0	35.0	0			10.0
	1963	4	443.6	74.0	81.0	35.0	20.0			10.0
Iraq	1960	6	62.1		16.7		1.5	0		
	1963	6	71.9		16.7		6.5	5.0		
Israel	1960	1	75.0	4.1	15.7					
	1963	1	75.0	4.1	15.7					
Jordan	1960	0	0							
	1963	1	6.6							
Kuwait	1960	1	171.0				3.8			
	1963	1	171.0				3.8			
Lebanon	1960	2	23.7				4.3			
	1963	2	23.7				4.3			
Neutral Zone	1960	2	80.0							
	1963	2	80.0							
Qatar	1960	1	0.6							
	1963	1	1.8							
Saudi Arabia	1960	1	189.0		25.0		14.0	15.0	1.0	1.2
	1963	2	209.0		25.0		14.0	15.0	1.0	1.2
Syria	1960	1	20.0							
	1963	1	20.0							
Turkey	1960	1	7.0	2.0	0	3.0	0	0	0	
	1963	5	117.9	2.0	2.2	3.0	7.2+	20.3+	0.4	
Total Middle East	1960	22	1,372.5	114.1	166.4	65.3	46.1	29.0	3.1	11.2
	1963	28	1,527.0	114.1	168.6	65.3	71.3+	54.3+	3.5	11.2

Country	Year	No. of Plants	Crude Capacity	Vacuum Distillation	Thermal[1] Operations	Catalytic Cracking	Catalytic Reforming	Desulfuriz.	Polymer.	Alkylation
Australia	1960	7	244.0	41.7		77.0	36.9	36.5	4.5	1.7
	1963	8	288.0	41.7+		88.8+	36.9	36.5	4.5	1.7
British Borneo	1960	1	46.0							
	1963	1	46.0							
Burma	1960	3	8.0							
	1963	3	8.0							
Ceylon	1960	0	0							
	1963	1	22.0							
India	1960	4	144.0	2.6	5.7	28.3	6.7		1.1	
	1963	6	200.0	2.6	5.7	28.3	6.7		1.1	
Indonesia	1960	6	273.8	12.0	59.0	10.0			1.6	
	1963	6	273.8	12.0	59.0	10.0			1.6	
Japan	1960	25	609.5	48.3	8.9	54.6	37.3	31.6		1.5
	1963	29	832.5	48.3+	14.3	77.1	83.1	70.1		1.5
Korea (South)	1960	0	0							
	1963	1	15.0							
Malaya	1960	0	0							
	1963	2	N.A.							
New Zealand	1960	0	0							
	1963	1	40.0							
Pakistan	1960	1	5.0							
	1963	2	37.0							
Philippines	1960	2	47.0	9.2		11.9	3.4	14.3	3.3	
	1963	4	82.0	9.2		11.9	3.4	14.3	3.3	
Singapore	1960	0	0							
	1963	2	40.0							
Taiwan	1960	1	35.0	12.0	4.5	10.0	3.1	5.5	0.9	
	1963	1	35.0	12.0	4.5	10.0	3.1	5.5	0.9	
Thailand	1960	1	1.0							
	1963	2	34.0							
Vietnam	1960	0	0							
	1963	2	N.A.							
Total Asia and Far East	1960	51	1,413.3	135.8	78.1	191.8	87.4	87.9	11.4	3.2
	1963	71	1,953.3	135.8+	83.5	226.1	161.2	130.4	11.4	3.2
Total Eastern Hemisphere	1960	207	7,050.4	500.0	602.6	738.9	594.4	503.0	57.4	21.1
	1963	265	9,079.1	517.5+	610.2	783.2	746.2	590.6	67.8	21.1
Total World[3]	1960	620	20,778.1	4,486.0	3,564.9	5,051.1	2,747.4	2,760.5	244.5	468.5
	1963	697	24,332.5	4,545.5	3,594.0	5,367.5	3,109.7	3,052.0	259.4	546.2
USSR and Bloc[4]	1960		2,648.0							
	1963		3,957.0[5]							
Grand Total	1960		23,426.1							
	1963		28,289.5							

[1] Includes cracking, reforming, visbreaking, and coking. [2] Includes Hawaii. [3] Excluding USSR and other Communist nations.

[4] Includes Albania, Bulgaria, China, Czechoslovakia, East Germany, Hungary, Mongolia, Poland, Romania, Yugoslavia.

[5] A forecast made July 15, 1959, for this 1963 total was 4,957.0; but it was based on a 1959 figure of 2,612.0 and a 1960 figure of 3,667.0. More recent data indicate a lag of one million b/d, hence this revised estimate.

Cumene and phenol/acetone units at Grangemouth plant of British Hydrocarbon Chemicals Ltd. in Scotland.

UK refinery capacity will exceed 50 million tons a year

by Cecil W. Wood
European Editor

Increase has been ten-fold in the past decade. And in petrochemicals, half of the country's organic chemical output now is based on petroleum sources

DURING THE LAST DECADE UK refining capacity has increased 10-fold and it will exceed 50 million ton/yr (1 million b/d) on the completion of projects now under construction. This can be taken as end-1960, when Esso Petroleum's 4.5 million ton/yr refinery (90,000 b/d) at Milford Haven (Pembrokeshire) will be on stream. There is no other major project in hand to affect refining capacity, but with the recent annual review of British Petroleum's chairman came the first news that the company is planning a refinery in Northern Ireland.

Based on design figures, UK refining capacity at mid-1960 can be regarded as virtually unchanged from the end-1959 total of 44.8 million (long) tons according to data on individual plants supplied to WORLD PETROLEUM.

There are, of course, several widely varying bases on which "capacity" can be presented. A current example is the Petroleum Information Bureau end-1959 figure of 42.7 million tons. The 2.1 million difference lies in the figure of 7.0 million taken for BP Kent refinery—the normal handling capacity instead of the design capacity of 9.0 million ton/yr. But the fact remains that the latter figure is the potential available.

UK refinery output in 1959, at 39.1 million tons, was again a new record for the third successive year. It was a rise of 6.2 million tons (18.8%) over 1958; and compared with the 1958 rise over 1957 of 5.1 million tons (18.4%), but 1957 was a year affected by the Suez Canal closure.

Information on refinery output of products, excluding imported and indigenous crude and process oils (including shale), independently collated on behalf of the UK Petroleum Industry Advisory Committee and published by PIB, is shown in condensed form in Table 1. The proportion of this output to total deliveries into consumption (excluding bunkers), as calculated by WORLD PETROLEUM, is shown alongside to give an idea of the extent to which UK refineries are meeting the demand for the main products.

The refinery output figures clearly reflect the continuing of an ever-increasing demand for gas, diesel and fuel oils, their total (including refinery fuel consumption) last year being 66.2% of the total finished product output against 64.9% in 1958 and 63.3% in 1957.

Ministry of Power preliminary figures show refinery throughput over the first two months of 1960 to be at the rate of just over 41 million tons a year, a rise of 3.5 million tons (9.3% over the same period of 1939).

Developments in 1959 (to mid-November) were reviewed in WORLD PETROLEUM, February, 1960, and the reports on project progress and on new projects which follow are confined to information released this year.

Esso Petroleum Co. Ltd. A carbon monoxide boiler costing about £650,000 was brought on stream at Fawley (Hampshire) refinery early this year. This latest addition to the fluid catalytic cracking unit can generate 300,000 lb/hr of steam by combustion of the CO-rich flue gases from the regenerator. The original waste heat boilers on the cracking plant revert to standby use and will be brought in when the new

boiler is down for statutory annual survey, thus allowing the cracker to run for two years between turnarounds instead of about 12 months.

Projects underway at Fawley include a £1 million plant to produce about 14,000 (long) ton/yr of lubricating oil additives due for completion and startup in November, and the enlargement of the chemical treatment facilities for jet fuel. Work will start this autumn on a 70-mile, 12-in pipeline from the refinery to a new 575,000-bbl terminal depot to be built west of London. It is hoped this service will be operating by 1962.

Esso's "grass roots" 4.5 million ton/yr refinery at Milford Haven (Pembrokeshire), being engineered and built by Foster Wheeler Ltd., should be in full operation before the end of the year.

British Petroleum Co. Ltd. At the Kent refinery the main recent development has been the construction of a 30,000 ton/yr special boiling point spirit plant. Erection started late in 1959 and completion was due by the end of June last. This is the first UK installation constructed by BP for this purpose and is built to BP design. Main contractors were Constructors John Brown Ltd. (process units), Motherwell Bridge Contracting & Trading Co. (tankage), and George Wimpey & Co. (associated piping and civil engineering works).

At the Grangemouth (Scotland) refinery all processing units associated with the expansion of crude distillation capacity from 2.2 to 3.1 million ton/yr are now commissioned, but work on certain tank reallocation and road and rail facilities continues.

Shell Refining Co. Ltd. At Stanlow (Cheshire) refinery a 140/145 F microcrystalline wax has recently come into continuous production, a grade hitherto only available from the U. S.

At Shell Haven refinery towards end-1959 a new bitumen blowing plant came into operation. Designed by Royal Dutch/Shell, the unit has a capacity of 300 to 600 tons a day depending on the grade of bitumen being manufactured.

Mobil Oil Co. Ltd. commissioned a gas purification plant late in 1959 at the Coryton (Essex) refinery. Capable of handling up to 4.5 mmcf/d, the unit purifies refinery tail gas for sale and transfer by pipeline to the North Thames Gas Board at Romford Another project completed last year was the removal of a process bottleneck to give a 25% increase in the manufacturing potential of lubricating stock oil.

Manchester Oil Refinery Ltd. continues to extend its Trafford Park facilities for producing specialized petroleum products. It recently completed a further extension of the petroleum sulfonate plant which, it is believed, brings its capacity for these products to a figure above that of any other manufacturer outside the USA.

Currently under construction is the rebuilding and extension of the electric generating plant which will make the refinery a net producer instead of a consumer. Any electricity in excess of refinery demand may be sold.

William Briggs & Sons Ltd. plans an early replacement of the No. 2 distillation unit at its Dundee (Scotland) refinery with a new unit of similar capacity—900 b/d.

Chemicals from Petroleum

The clearest indication of the great spurt in activity in the UK petroleum-chemicals industry in 1959 is to be seen in the monthly average rise of 19,600 long tons (28.3%) over 1958 in the amount of base stock made in domestic refineries. The details are shown in Table 2.

Thus over the first quarter of this year, feedstock delivery has been 27.5% higher than the 1959 average.

Authorities appear to agree that one half of the UK output of organic chemicals is now based on petroleum, and the proportion is likely to rise substantially. Petroleum has also become a more important raw material in the manufacture of such inorganic chemicals as ammonia and its fertilizer derivatives.

The Chemical Products Committee of the Organization for European Cooperation, which defines a petroleum chemical as "an organic substance the main materials of which have come from oil or refinery gas or natural gas," has for some years admitted it has found it difficult to draw up a useful and precise report on activity in this large and highly complex industry.

To judge by "The Chemical Industry in Europe 1958-1959," issued recently and the sixth report in this series, this difficulty shows no signs of solution; the attempt to secure a precise report does not appear to have met with much success. The current report states that some OEEC countries have not considered it possible to supply figures with the method desired, and few have been able to reply to the committee's questionnaire in its entirety. The report, however, is the only authoritative source of statistical guidance available. The committee finds that UK production of petroleum chemicals (in terms of carbon content) in 1958 amounted to 302,000 metric tons, compared to 274,000 tons in 1957 and 148% over the 1953 level. It expectes a more substantial increase in 1959, when output is estimated at 378,000 tons. Production details and the changes over the years are shown in Table 3.

Of the OEEC countries for which 1958 data is given, the UK output is easily in the lead. It compares with Germany at 246,000 tons, France 118,000 tons, Italy 82,000 tons (excluding Ravenna synthetic rubber plant production), and Netherlands 49,500 metric tons.

The UK should still be in the lead in

TABLE 2—Liquid Feedstock for Petrochemicals Delivered from UK Refineries for Inland Consumption

Monthly Averages in Long Tons and Index (1953 = 100)

Year		Year	
1953	42,300 (100)	1957	66,100 (156)
1954	50,600 (120)	1958	69,300 (164)
1955	47,200 (112)	1959	88,900 (210)
1956	55,500 (131)	1960*	113,300 (268)

* January to March

TABLE 1—UK Refinery Output and Proportion of Deliveries into Consumption

(Excl. bunkers)

	Refinery Output 1,000 tons		Ratio of Deliveries met by Refineries Percent	
	1959	1958	1959	1958
Motor and aviation spirits	7,531	6,751	86.0	82.4
Industrial and white spirits	141	144	38.8	43.2
Kerosine	1,773	1,292	112.8	82.3
Gas/diesel oils	7,241	6,285	116.1	117.7
Fuel oil*	18,631	15,076		
Lubricating oil	863	751	93.0†	86.1†
Bitumen	961	859	97.0	99.0
Paraffin wax and scale	31	30	60.7	57.7
Propane and butane	126	91	100.0	100.0
Misc. products‡	1,838	1,654		
Total	39,136	32,933	107.2	106.0

Notes: * Output includes refinery fuel consumption (ex own production): 1959—3,032,084; 1958—2,503,445. † These percentages may only be approximate, for whereas refinery output is given as "lubricating oil," deliveries are "lubricating oils and greases." ‡ Output includes "loss" and thus no ratios are calculated: "miscellaneous products," it is of interest to not are largely feedstocks for chemical manufactures.

Imperial Chemical Industries' units at Wilton for manufacture of ethylene oxide/glycol and propylene oxide/glycol.

TABLE 3—UK Output of Organic Chemicals from Petroleum

Year	Metric tons of contained carbon	Index 1953 = 100	Percent over previous year
1954	162,000	133	32
1955	195,000	160	21
1956	220,000	176	10
1957	274,000	225	25
1958	302,000	248	10
1959*	378,000	310	21

* Estimate.

1959, when German output is estimated at 334,600 tons. The Chemical Products Committee sees the growth rate of the European petroleum chemical industry as certainly higher than that of industry in general and of the chemical industry in particular. It believes that the European petroleum chemical industry should be able to cover, and probably more than cover, European demand for petroleum chemicals in 1961, although there are likely to be still some products in short supply.

As to UK capital investment, in its 1957-1958 report the committee estimated the total to end-1957 at $212 million (including $24 million in respect of utilities and general facilities in 1957, a factor previously excluded from these calculations). For 1958, investment is seen as increased by $53 million, raising the aggregate over the period 1953-1958 to $265 million.

"At the time of writing," says the committee—presumably about November 1959—five petroleum chemical companies have UK plants planned or under construction, and these will require the investment of a further $144 million and will enable production to be increased by about 240,000 tons of carbon content.

Although no separate UK figure is given, the Royal Dutch/Shell group report for 1959 gives a clear indication of the large part chemicals from petroleum have come to play in that company's overall finances and activities. Such products accounted for 9.3% of total net sales in 1959, yielding £178 million or a rise of 17% over 1958; and in volume sales rose to 3,400,000 (long) tons in 1958 from 2,900,000 tons in both 1958 and 1957. Group capital expenditure on chemical plants over the years 1955 to 1959 was £108 million (5.6% of total capital and exploration expenditure), of which £26 million was spent in 1959 and £22 million the year before. The amount spent on research on chemical processes and products is now greater than that spent on all processes and products.

The OEEC 1958-1959 report states that UK production of carbon black (over 95% of which is regarded as based on petroleum as raw material) rose by 4% in 1958 to 110,600 metric tons, comparing with 106,000 tons in 1957. The upward trend continued into 1959, when output for the first 6 months was put at 61,300 tons.

TABLE 4—UK Consumption of Surface Active Materials
(Basic ingredient of synthetic detergents) in long tons

Year	Domestic	Industrial	Total
1959	37,500	7,400	44,900
1958	35,000	7,300	42,300
1957	34,100	6,900	41,000
1960	12,500	2,700	15,200

There has been little change in total UK consumption of powdered synthetic detergents but an increase in the domestic use of liquid types over the last 2 years. See Table 4.

The following information has also been reported on estimated UK consumption in 1958 of liquid detergents by types: alkyl sulfates secondary, 1,520 tons; alkyl biologically soft sulfonate, 710 tons; alkyl biologically hard sulfonate, 510 tons; alkyl sulfates primary, 480 tons; and nonionics, 980 tons; total, 4,200 tons.

Progress of thermoplastics in the UK in recent years has been largely progress of the three "polys"—polyethylene, polyvinyl chloride and polystyrene—with PVC still ahead on tonnage but polyethylene now expanding most rapidly.

UK plastics production today is put at around 500,000 tons. The Board of Trade reported net sales in 1959 as a record of 500,800 tons, a rise of 85,000 tons (20.5%) over 1958 and surpassing the rapid rate of growth (16%) achieved in 1957. Sales in 1959 are divided into thermoplastic materials, 307,900 tons (244,000 tons in 1958) and thermosetting materials, 192,800 tons (171,000 tons in 1958). By far the largest increase was again in sales of polyethylene, which were 44% higher than in 1958. The 1959 sales figure is the first time the British plastics industry has passed the half-million ton mark.

The latest information available on UK plant projects for producing chemicals from petroleum follow:

Imperial Chemical Industries Ltd. has started work on the new Severnside Works on a 1,000-acre site near Thornburty, Gloucestershire, on which capital spending of some £100 million is envisaged over the next decade.

Work began in the spring with the expenditure of £5 million on initial site development and the construction of two plants to make 35,000 tons a year of ethylene oxide, ethylene glycol and associated products. Ethylene will be supplied by Esso Petroleum Co., which is adding another steam cracker at Fawley to produce ethylene, butene and propylene by end-1961 at a cost of £5.5 million, and also planning to lay a 75-mile pipeline costing £800,000 to supply ethylene to Severnside.

ICI will be the first company in the UK to operate Scientific Design Co.'s process involving direct air oxidation of ethylene to ethylene oxide. The plants for ethylene glycol and associated products will be of ICI design. Production is due to start in about two years.

As to the seeming departure from the company's established practice of producing ethylene by naphtha pyrolysis, it is explained that it represents the "marriage" of two opportune factors: Esso's helpful agreement to supply ethylene at the rate of 40,000 tons/yr and ICI's sanguine view of current and future market requirements for olefins and their derivatives. A return later to naphtha pyrolysis is seen as likely when demand for other olefins is established at Severnside and when ethylene offtake is sufficient to support a large olefin plant.

The second Severnside project will be a 100,000 ton/yr ammonia plant, with associated plants to make urea and fertilizers, estimated to cost over £10 million and to be producing in 1963.

Ethylene production by the Heavy Organic Chemicals Division at Wilton is being expanded this year by not less than 20% from the current 110,000 tons/yr and capacity may be up to 140,000 tons by end-1960.

The Wilton 10,000 ton (20 million lb/yr) polypropylene plant based on Montecatini and Montecatini/Ziegler UK patents will be on stream by the end of the year.

Propylene oxide and propylene glycol came into commercial production this year as one result of the completion of an extension of propylene capacity to 80,000 tons/year.

At Wilton by late 1960 "Terylene" capacity will have been raised from 20 to 50 million lb/yr. By the same time polyethylene capacity will have gone up from 90,000 to 105,000 tons/yr; and plants will shortly come on stream for producing "Topanol" refined grades of butylated hydroxytoluene antioxidants, thus extending ICI's interest in these compounds into agriculture and human foods.

At Billingham, the new acrylonitrile plant of General Chemical Division went into large-scale production this year as scheduled. Synthetic phenol plant capacity is being raised from 15,000 to 20,000 tons a year, and extensions continue to be made to the current 60,000 ton/yr carbonylation plant capacity to consolidate the company's position as the world's largest producer of plasticizer alcohols.

Shell Chemical Co. Ltd. and Petrochemicals Ltd. What may be regarded as the UK petrochemical highlight of 1960 is the entry of Shell into the synthetic rubber field. Work has started at Carrington (Cheshire) to establish "substantial" production capacity for the new polydiene synthetic rubbers based on Royal Dutch/Shell research and development. This will take 2 to 3 years to complete.

Representative types of these rubbers are polybutadiene and polyisoprene; the latter is already made commercially by Shell in the US, but polybutadiene is not so far made anywhere on a commercial scale. The process by which these new chemicals from petroleum will be made is described as an application of the Ziegler and Matta techniques to the making of synthetic rubber, the essential feature being the use of organometallic catalysts to produce polymers which can be controlled readily at low pressure.

At Carrington a new 18,000 ton/yr monostyrene unit erected by Matthew Hall & Co. was brought on stream recently. A direct oxidation plant which will increase Petrochemicals' ethylene oxide capacity

from 20,000 to 45,000 tons a year was also put into operation recently.

Work on the new polyolefin plant at Carrington is on schedule, with completion due in 1961. This plant will give 30,000 tons a year of polyethylene and polypropylenes, including high-density polyethylenes made under Ziegler license.

The position of Shell Chemical Co. in the fertilizer field—which started last year with completion of the 75,000 ton/yr plant to make ammonia, nitric acid, and "Nitra-Shell" by fuel oil gasification—has recently been strengthened by the introduction of a new highly concentrated compound fertilizer. Its analysis of 17% N, 11% P_2O_5, and 22% K_2O, a total of 50% plant nutrients, is claimed to give it a higher percentage than any other granular-compound currently available in the UK and it is Shell's first entry into this market. It is stated to be formulated by an advanced manufacturing technique involving the use of ammonium nitrate, diammonium phosphate and potassium dichloride.

British Hydrocarbon Chemicals Ltd. (50% The British Petroleum Co. and 50% The Distillers Co.)—Three new major projects at Grangemouth (Scotland), to cost £5 million, were announced in March. One plant, to be built by Fluor Engineering & Construction Co., will more than double the existing capacity for butadiene; the other two, for the production of methanol and ethylene dichloride, are to be built by Chemical Construction (Great Britain) Ltd. and Lummus Co. respectively. All three plants are due for commissioning in 1961.

A third ethylene plant, of about 70,000 ton/yr capacity, was commissioned at mid-year. It will more than double the olefin capacity at Grangemouth and the combined feedstock requirements of the three BHC cracking plants will be nearly a million tons/year.

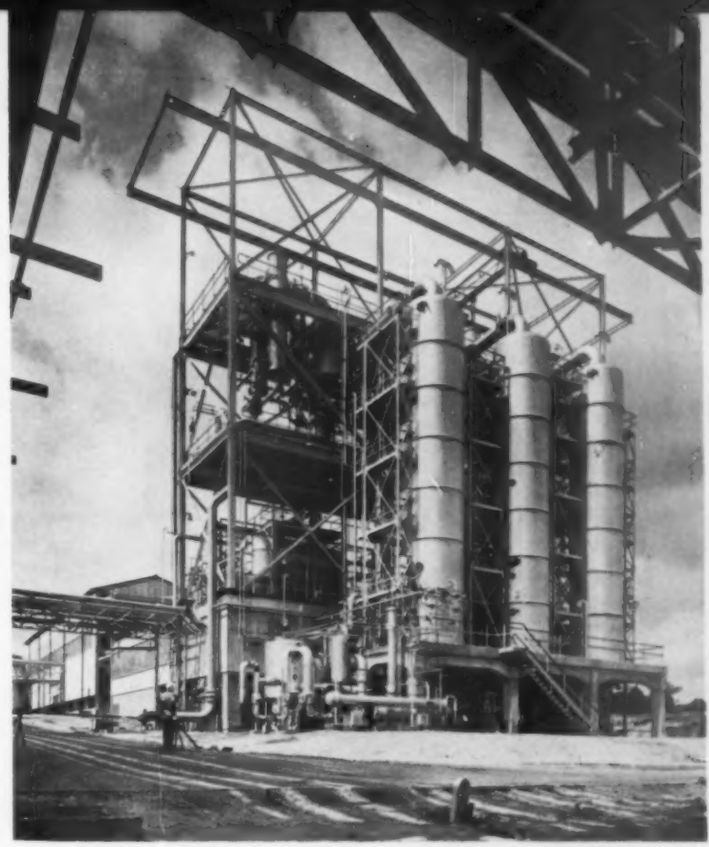
This year has also seen a 29,000 ton/yr cumene plant and a 13,000 ton/yr phenol/acetone plant brought on stream. Both plants are the first of their type in the UK. Surplus cumene which is not required for phenol production is being exported to Europe.

The cumene unit was built to Scientific Design Co. Inc. (USA) specifications, and the phenol/acetone unit uses the process developed by Distillers Co. Main engineering and construction contractors for both units were Stone and Webster Engineering Ltd.

Forth Chemicals Ltd. (66-2/3 British Hydrocarbon Chemicals and 33-1/3 Monsanto Chemicals) is expanding the monostyrene plant at Grangemouth from 30,000 to 50,000 tons/year, with completion due by the end of 1960.

Completion of the above projects will bring the total investment of British Hydrocarbon Chemicals at Grangemouth to over £35 million.

Distillers Co. Ltd.—a £2 million acetic acid plant, first of its kind in Europe, is to built at Hull, with completion expected early in 1962. It will use a new process developed by the company, based on the direct oxidation of a light oil fraction instead of the normal two-stage route based on ethyl alcohol.



Styrene/butadiene recovery unit at the Hythe plant of International Synthetic Rubber. Co.

Esso Petroleum Co. Ltd. plans additional facilities at Fawley to increase substantially the production of ethylene and butadiene.

Union Carbide Ltd. In mid-May initial production of ethylene oxide and derivatives started at the Hythe (Hampshire) plant. This £3 million project, with a capacity of 45 million lb/yr, includes facilities for producing ethylene glycols, polyethylene glycols, ethers, esters, ethanolamines and surface active agents. The facilities installed occupy 25 acres, leaving 33 acres for future expanion.

At Grangemouth (Scotland), a 30 million lb/yr polyethylene plant is being expanded to 60 million lb/yr capacity by the end of 1960. Detailed design, procurement and construction have been entrusted to George Wimpey & Co. Ltd.

Monsanto Chemicals Ltd. A polyethylene plant at Fawley (Hampshire) came into production mid-1959 at an initial rate of about 10,000 ton/yr, but capacity has already been raised to 17,000 ton/yr and further expansion is contemplated. Also planned for this year are additional polystyrene and rubber chemical capacity, and completion of the new 15 million lb/yr maleic anhydride plant at Newport in South Wales.

British Geon Ltd. (55% Distillers Co. and 45% B. F. Goodrich Chemical Co., USA) plans a £2 million extension of its polyvinyl chloride plant at Barry in south Wales with completion the second half of 1962. No capacity figure is given, but one authority estimates the current figure at around 30,000 ton/yr, and that this may be raised by 50%. A possible link was also seen between this announcement and that of British Hydrocarbon Chemicals for a new plant to make ethylene dichloride: the suggestion is that British Geon may use the BHC product as the base material for polyvinyl chloride, thus adopting current US practice and departing from past UK practice of basing it on acetylene.

The International Synthetic Rubber Co., Ltd. is expanding the Hythe (Southampton) SBR plant, from 70,000 to 90,000 ton/yr, and work is also proceeding on a 2½ million gal/yr of high solids latex.

UK consumption of solid styrene/butadiene rubbers is now about 60,000 (long) ton/yr, compared with 45,000 tons in 1958, and a steady rise is foreseen. The International Rubber Study Group puts 1960 consumption at 100,000 tons of synthetic rubber and 170,000 tons of natural rubber.

Dunlop Rubber Co. Ltd., which has a 45% share interest in International Synthetic Rubber revealed recently that it was using the synthetic product for 39% of its total rubber requirements against 36% in 1958—and three times as much as it did in 1955.

Witco Chemical Co. Ltd. an affiliate of the American concern, Witco Chemical Co. Inc., and a newcomer to the UK petroleum chemical industry, is to build an 8 million lb/yr plant in the Midlands to produce an extensive range of synthetic rubber latices of various types. The company's past work in this field has been confined to compounding synthetic and natural latices at Droitwich (Worcestershire). END

General view of Ferrara, Italy, plant of Montecatini, showing a portion of the olefin manufacturing units

ITALY 1959 — in a wealthy economy a booming petrochemical industry

by Alberto Girelli*

THE ITALIAN OIL and natural gas panorama for 1959 showed two general trends of industrial development: good progress in production and refining (with perhaps a few dark spots), and a booming expansion of petrochemical activity.

In the overall frame of the country's economy—marked by a 10% increase in industrial activity as a whole and a sparkling 19% increase in the chemical industry—petroleum and natural gas played a major role. The greatest part of the chemical activity increase is, in fact, due to the extension of petrochemical production, with many new plants on stream, expansion of existing ones, and several more being erected or planned.

Private companies as well as government owned enterprises have been equally active in petrochemicals. The rate of expansion in this field will eventually smooth out as far as ammonia and nitrogen fertilizers are concerned, but it is likely to keep up the pace—and even increase—in other areas such as olefins and olefin polymers, acetylene and derivatives, plastics and elastomers, and petrochemical intermediates.

Refining: Tables 1 and 2 give the data on crude run to stills—from imports, domestic production, and reprocessing of residua—and on the three primary destinations of processed crude: for the internal market, for export and for foreign companies under contract agreements (as conventionally classified by the Italian official statistics). In Table 3 is a breakdown of product distribution in 1958 and 1959. Italian consumption of the different products, in absolute quantities, is reported in Table 4.

Table 1—Italy's crude runs to stills, 1958 and 1959
(total metric tons)

	1958	1959	Percent change
Imported crude oil	22,836,579	25,021,162	+9.6
Domestic crude oil	1,327,663	1,190,688	−10.3
Residua	20,171	106,011	−530.0
Totals	24,184,413	26,317,861	+8.8

Table 2—Italy's crude oil destination, 1958 and 1959
(total metric tons)

	1958	1959	Percent change
For internal markets	15,267,828	17,991,220	+17.8
For export	5,848,021	4,473,319	−23.5
For foreign customers	3,068,564	3,853,322	+25.6
Totals	24,184,413	26,317,861	+8.8

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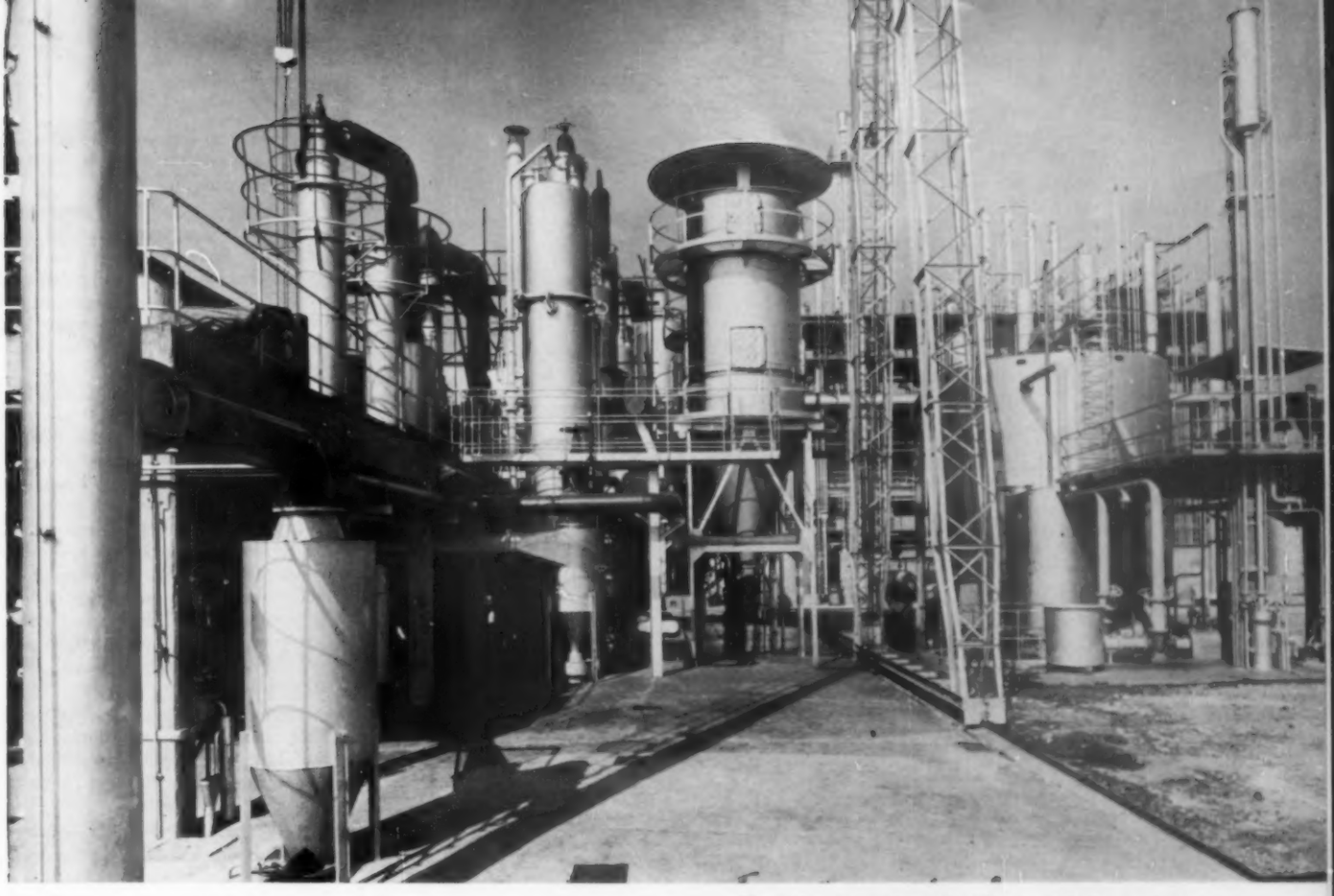


The methane-to-acetylene unit at Montecatini's Novara plant

An increase of 8.8% in crude runs and of 12.6% in domestic consumption of products may look fairly good under an absolute basis; however, the percentage increase in Italy has been slower than in other countries of western Europe. Internal consumption increased, in the same year, by 21% in Western Germany and by 15% in Great Britain. Italian consumption of energy per capita is still lagging behind the more highly developed European countries, with one ton equivalent of coal per year against an average of 2.3 tons for the OEEC countries and peaks of 6 tons in Germany and 5 tons in Great Britain.

Operating patterns of refineries did not change substantially from what is considered traditional in Italian industry. Internal demand of products remains much stronger for residual fuel oil than for light ends (see Table 5).

Yields of gasoline increased slightly, thanks to the rapid expansion of motoring all over the country, with an increasing tendency to shift from scooters and miniature cars to small but "real" automobiles of better performance and higher fuel consumption.

Due to the existing surplus in refining capacity, the increasing production did not carry with it any substantial expansion of existing facilities last year. New crude stills or expansion of existing ones was kept at the minimum necessary to keep refineries up-to-date.

The addition of new process units for upgrading products has continued—such as catalytic reforming, reformer feedstock hydotreating, and gas oil desulfurization. Today's Italian refineries rank among the most modern and efficient in Europe. Solvent extraction of aromatic hydrocarbons is being adopted by some of the large refineries. The shortage of aromatics is felt in Italy as elsewhere, especially for the expanding demand from petrochemical companies producing stryrene, phthalic anhydride, detergent alklyate, and the like.

Crude sources: Domestic production of crude oil did not increase noticeably; 1.65 million ton were produced, mainly from the Ragusa (Sicily) oil field developed by Gulf Italia. A sharp increase is not expected before the start of a full scale development of the Gela field in Sicily by AGIP-Mineraria, which is bound to the construction of an

Table 3—Products of Italian refineries, 1958 and 1959

(total metric tons)

	1958	1959
Gasoline, regular	2,734,973	2,968,043
Gasoline, premium	587,238	749,799
Kerosene	477,572	446,413
Jet fuel	716,218	580,748
Gas oil	4,670,163	5,188,612
Fuel oil	11,898,894	13,044,979
Lubricants	159,051	158,825
White & transformer oils	9,653	8,363
Solvents	40,087	35,480
Asphalt	562,189	633,853
Gas	499,972	572,575
Feedstock for petrochem uses	131,440	255,076
Others	154,071	93,682
Refinery consumption & loss	1,546,802	1,587,414

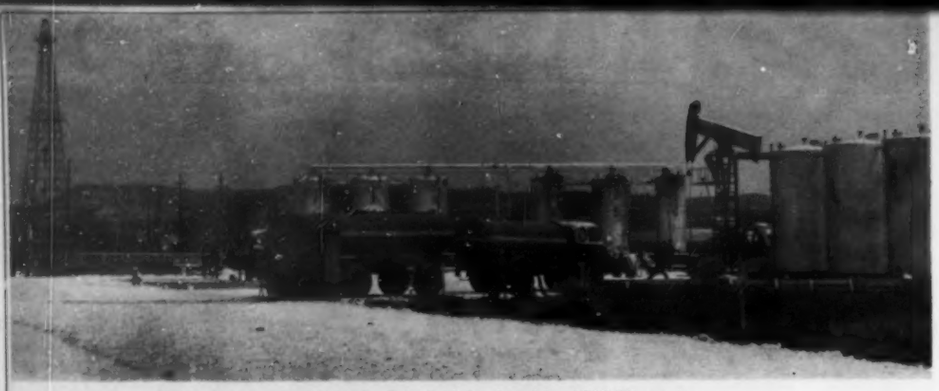
Table 4—Italian consumption of petroleum products, 1958 and 1959

(in 1,000 metric tons)

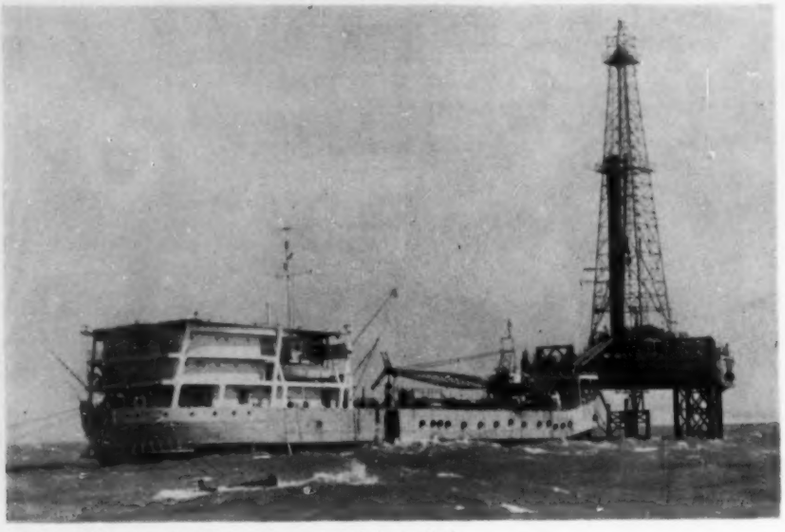
	1958	1959	Percent change
Gasoline	1,765	2,025	+14.7
Kerosine	156	157	+0.6
Jet fuel	210	200	−4.8
Gas oil	2,128	2,362	+9.3
Fuel oil	7,500	8,520	+13.6
Lubricants	203	210	+3.4
Asphalt	470	535	+12.8
LPG	510	585	+12.6
Others	70	68	−2.8
Totals	13,012	14,662	+12.6

Table 5—Italian consumption of petroleum products, 1959

	Percent
Gasoline	13.06
Kerosine	0.96
Gas oil	15.01
Lubes, asphalt, LPG	8.20
Fuel oil	53.87
Refinery consumption and loss	8.90



Field storage and wells in the Gela field developed by AGIP-Mineraria



Offshore drilling by AGIP-Mineraria south of Gela, in Sicily

integrated oil-chemical complex to be operated by ENI's ANIC company. The project, recently approved by the government authorities, calls for a 100 billion Lire ($150 million) installation, especially designed for handling the heavy (9° API) and high sulfur content (6 to 7 wt-%) bituminous Gela oil.

Operations at Gela will be centered around a huge coking unit to treat the whole crude, for the production of (1) a "synthetic crude" of characteristics close to those of the average Middle East oil, (2) coke, and (3) sulfur and/or sulfuric acid. The synthetic crude will be the starting material for a series of refining and petrochemical operations. The coke will be used as the fuel for a large power plant to supply energy to the ANIC works and to other commercial and domestic users.

Table 6—Origins of Italian crude oil imports

(in 1,000 metric tons)

	1958	Percent	1959	Percent
Saudi Arabia	5,936	24.47	5,825	22.05
Egypt	1,130	4.66	1,025	3.78
Iran	497	2.05	1,425	5.96
Iraq	4,685	19.32	5,600	21.46
Qatar	1,170	4.62	275	1.02
Kuwait	7,440	30.65	8,100	29.89
USSR	1,051	4.30	2,125	7.34
Venezuela	730	3.01	825	2.51
Others	81	0.53	—	—
Totals	22,720		25,200	

In 1959, as in prior years, the largest amount of crude run to Italian refineries came from abroad, with the Middle East decreasing its share from 91.1 to 80.4%, and the Soviet Union increasing from 4.3 to 7.3%. A complete picture of the imports of crude oil from various countries is given in Table 6.

Soviet oil comes in mainly under barter trade agreements with the ENI group. ENI claims lower prices for Soviet crude as compared with international prices of Middle East oil. However, it is to be noticed that goods supplied by ENI for the Soviet oil are sometimes sold below international prices. This has been especially the case for nitrogen fertilizers and for the synthetic rubber "Europrene" from the ANIC works at Ravenna.

Drilling activity is being developed regularly by Gulf Italia in Sicily to complete and rationalize the exploitations of the Ragusa field, and by AGIP-Mineraria, mainly to extend and develop the Gela field, which extends far offshore the southern Sicilian coast.

Natural gas exploration is slowing down in the Po Valley, where the major share of present production originates--6.2 billion cubic meters in 1959. However, good news came from the south where the Ferrandina (Matera) field discovered by AGIP-Mineraria early in 1959 is credited a potential daily production of about 10 million cubic meters. A pipeline to connect the field to Bari and other towns on the Adriatic coast will begin operating early in 1961.

Petrochemicals. The development of chemical uses of petroleum and natural gas started in Italy by Montecatini is presently being pushed by the three largest Italian chemical companies — Montecatini, Societa Edison, and ANIC. The more interesting developments during 1959 are summarized briefly.

During the summer of 1959, a new olefin plant started production at the Ferrara works of Montecatini. Its capacity, 30,000 ton/yr ethylene and 30,000 ton/yr propylene plus C_4 hydrocarbons, increased four times the existing olefin capacity at Ferrara.

In March, ground was broken near Brindisi to start construction of the seventh petrochemical plant of Montecatini in Italy. Scheduled to start production early in 1962, it is designed to treat about one million ton/yr of crude oil and produce a range of polymers, solvents, alcohols, and intermediates.

Production of the new polypropylene fiber "Meraklon" was started during the year by the Montecatini subsidiary "Polymer" at Terni; the goal for the near future is 30,000 ton/yr of this material.

Activity in the chemical divisions of the Edison group has been centered on petrochemicals. The company's plants—located at Porto Marghera (Venice), Mantua, and near Catania—reached in 1959 the overall capacity of 700,000 ton of nitrogen fertilizers and 100,000 tons of vinyl and other resins. Early in the year, the Mantua works entered full operation with a 25,000 ton/yr olefins plant.

Another olefin plant has gone on stream at the Edison subsidiary "Sincat" at Priolo (Sicily); and the other Edison petrochemical subsidiary "Celene" is presently in full production turning out 25,000 ton/yr of polyethylene and other olefin derivatives.

The petrochemical company of the ENI group, ANIC, in 1959 produced 350,000 tons of ammonium sulfate, 250,000 tons of ammonium nitrate, 40,000 tons of styrene-butadiene synthetic rubber. Expansion under way will raise fertilizer capacity to one million tons and synthetic rubber to 80,000 tons.

Petrochemical activity is not confined to the above mentioned "big three." A number of medium and small concerns are presently producing a wide range of chemicals from petroleum and natural gas.

Worthy of mention are: (1) ABCD, a subsidiary of the Bombrini Parodi-Delfino group (explosives, pesticides, heavy chemicals), which is starting production of 12,000 ton/yr of high pressure polyethylene at its Ragusa plant; (2) the Solvay Co., producing about 10,000 ton/yr of polyethylene at Rosignano near Leghorn; (3) Ftalital at Scanzorosciate (Bergamo), producer of phthalic and maleic anhydride, is boosting maleic capacity from 1,500 to 10,000 ton/yr. Maleic anhydride capacity expansion, to 3,000 ton/yr, is also under way at Terni by Bombrini Parodi-Delfino. END

Aerial view of the Slagen refinery of A/S Esso-Raffineriet Norge. Marine terminal is in foreground; process area being developed in left background beyond tank storage area.

Norwegian refinery nears completion

Construction of new 40,000 b/d facility—the country's first major refinery—met and solved unique topographical problems

by G. W. Gross and E. M. Sansom
Esso Research and Engineering Co.
Florham Park, N. J.

CONSTRUCTION IS approaching the final stages on a new 40,000 b/d "grass roots" refinery at Slagen, Norway. This refinery, located on the Oslofjord about 70 miles south of Oslo, will go into operation late this year, and will be Norway's first major petroleum refinery and Scandinavia's largest.

Being built by A/S Esso-Raffineriet, Norge, a Jersey Standard affiliate, the refinery is designed to meet all of Esso's major marketing requirements in Norway. During the initial years of operation, a share of its production may be exported to Esso marketers in other Scandinavian countries.

This Norwegian project was highlighted by several unique and interesting developments. A number of these resulted from the topography of the Slagen site. Thus, it is appropriate that a discussion of the features of this refinery be prefaced with background information on the site itself.

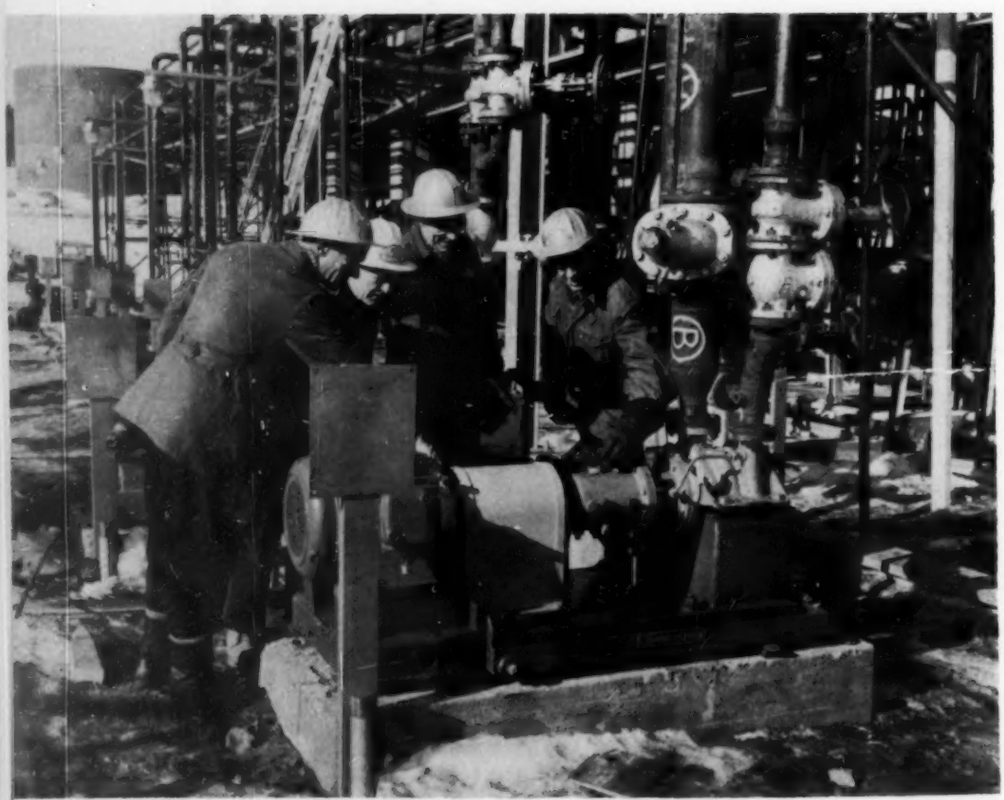
The site at Slagen was chosen after an intensive investigation in which a large number of locations were examined. An unusually extensive program was required for two major reasons.

First, transportation and marketing considerations indicated that a site on the Oslofjord was preferred, but the general prevalence of a high rocky shoreline along this fjord made it difficult to find a large tract of land suitable for economic development.

Second, it was found that a rather unusual soil condition occurs in Norway. This phenomenon—a rare clay formation—precludes the economic development by heavy industry of the land affected. Thus, the search for a refinery site had to be intensified in an effort to find an area relatively free of such formations and at the same time suitable in other respects.

The history and nature of the rare clay formations mentioned above are of particular interest. During the Ice Age the terrain along the Islofjord was covered by ice so thick the earth's surface was de-

Project manager at the Slagen refinery for Esso Research and Engineering Co. is George J. Doll. After completion of the basic design work in the home offices Mr. Doll was resident in Rome for the engineering and procurement stages of the project. He is currently in Norway for the final stages of construction. Mr. Doll joined the company in 1939 and has recently been associated with projects for South Africa, India, and the Far East.



A group examining a pump installation in the copper chloride unit: G. Jensen, R. MacMillan, R. Jensen, and J. Salvador. The Jensens are Norwegian foremen who previously were whaling ship chief engineers who stayed home last season to work on the refinery project. Messrs MacMillan and Salvador are Americans attached to Esso's resident field staff.

pressed several hundred feet. As the ice melted, rivers formed which deposited layers of clay material on the terrain. With the gradual relaxation of the ice overburden, the present land areas rose out of the sea. Originally, the clay deposits were kept firm by their natural salt content, but this stabilizing element has been gradually removed as a result of leaching by rain water. Today, the deposits remain in a solid state if left undisturbed. However, their water content is above the liquid limit, and they behave as a fluid when disturbed. Thus, they are termed "quick" clays .The only other part of the world where this phenomenon is known to occur is northern Canada. Experience has shown it is extremely difficult and costly to build heavy structures over these unusual clay deposits.

The investigation resulted in the purchase of a site located on a peninsula on the west side of Oslofjord. It lies close by a part of the community Sem, called Slagen, from which the refinery derives its name. It is convenient to major marketing areas, and tankers of the 100,000-dwt class can be accommodated at all times during the year.

The land slopes from a ridge that runs along the western property line. About midway along this boundary line, the ridge reaches a high point of about 165 ft. above sea level. Fall lines traverse the site, radiating to the north, east, and south from this point. Surface soils are predominantly sand and gravel with occasional rock outcroppings. The ridge mentioned above is characterized by heavy rock formations. There are some quick clay deposits on the site. However, they are confined to areas not required by the refining facilities and thus do not present a serious problem.

The nature of the Scandinavian market demand for petroleum products indicated that the refinery should be designed to maximize the production of middle distillates and minimize gasoline production. Thus, a refinery of the hydro-skimming type was planned. Middle East crude will be processed. Products will consist of gasolines, jet and tractor fuels, diesel and heating oils, and light and heavy fuel oils.

Crude oil will be distilled in a 42,000 b/sd single stage atmospheric pipe still having four sidestreams. A Powerformer is provided for gasoline octane improvement. Sulphur will be removed from gas oil in a Hydrofiner, and copper chloride treating is provided to sweeten gasoline and distillate blend stocks.

Every effort has been made to make these processing facilities as up-to-date, efficient, and economical as possible. Electronic instruments are used throughout for process control. Cooling is accomplished with fin-fan coolers, which use air as the cooling medium. This obviated the necessity of installing an otherwise expensive and potentially troublesome cooling water system. At Slagen all process units and the steam plant are designed to be operated as a single unit from a common control house. This resulted in a more efficient utilization of space and operating manpower than otherwise

possible. Further, the Powerformer and gas oil Hydrofiner are designed to receive feed directly from the pipe still, thereby saving the investment and operating cost associated with storing these feeds cold between processing steps and then reheating them as part of a successive operation.

Generally speaking, the refinery is laid out in a north-south direction. The marine terminal is at the north end of the site. South of the terminal are, in order, the crude storage facilities, product storage, intermediate storage, the processing facilities, and the administration and service facilities.

Some of the more interesting features of this refinery resulted from studies directed at achieving an optimum refinery layout for this sloping, somewhat rocky site. To assist in these studies, a scale model of the terrain was prepared which portrayed the differential elevations. This helped to locate the various refinery components in a manner that minimized the amount of rock blasting required. It also helped to determine the natural drainage routes. With most storage located on sloping land, knowledge of these routes permitted a system of diversion walls and open ditches to be developed which, with proper orinetation of the tankage, obviated the need to install a more conventional, but more costly, fire wall system.

In general, tankage is oriented in rows perpendicular to the fall lines. There are no fire walls between tanks in the same row. Each row is separated by a diversion wall that directs any flow to open ditches. These ditches empty into a central impounding basin and oil-skimming pond located near the waterfront. This system of diversion walls and open ditches is designed to handle storm water as well, and no separate enclosed storm water drainage system is necessary.

Essentially all products will be transported from the refinery in barges and tankers. In order to handle these deliveries, plus crude receipts, a marine terminal had to be provided that would accommodate large numbers of vessels ranging in size from small barges up to 100,000-dwt tankers.

To arrive at the optimum number and sizes of berths needed for this traffic, a careful analysis of the ship arrival patterns was made. Based on these studies, a single pier with three berths is being provided. One berth is designed to receive tankers up to the 100,000 ton class. The other two berths will accommodate the barge traffic, and one of these will also receive coastal tankers up to 19,000 dwt.

Such a complex and relatively large marine operation called for a modern and efficient loading system. For each berth, a hose handling system employing remote controlled metal arms equipped with swivel joints was designed that will give rapid, accurate positioning of the loading arms. These arms can be properly positioned and connected to any vessel expected at the berth—a rather large order considering the range of vessel sizes and shapes that will be used.

The number of product pipelines has been minimized by using pigs in all lines between tankage and the marine terminal. Thus, it was not necessary to provide a separate line for each product.

The pigs used are bidirectional and require no handling or removal from the line. This is accomplished by using inert gas under pressure as the driving force that returns the pig to the desired position after each product loading operation. The location of the pig in the line is indicated by an automatic signaling system.

When the lines are not in operation, they are filled with inert gas. Thus, there is no need to keep the lines at elevated temperatures. This resulted in a reduction in the amount of insulation and steam tracing required in the refinery—an important saving in such a northerly climate.

Norway has a Good Neighbor Act which has as its purpose the protection of individuals from noise, pollution, property encroachment, and other nuisances and disturbances created by their neighbors. Strict adherence to good neighbor principles has been an important consideration in the design and layout of the refinery facilities.

For example, emergency refinery gases will be inconspicuously disposed of in a flare that will give a smokeless, nonluminous flame. The use of equipment that would produce a high level of noise has been avoided, and furnace noise will be reduced by the use of burner mufflers. The ballast water tank and oil-skimming pond will serve to protect the fjord waters from oil contamination. Further, the natural beauty of the countryside has been preserved as much as possible by maintaining a belt of trees around the refinery.

The efforts associated with designing and building this refinery represent a truly international undertaking. The basic design of the refinery was done by the Esso Research and Engineering Co. in Linden, New Jersey who, as Esso-Raffineriet's engineers also have the responsibility of supervising the contractors. European Bechtel Corp. was awarded the detailed engineering and construction of a major portion of the refinery. This engineering work was carried out in Rome under Bechtel's supervision by Compagnia Tecnica Industrie Petroli. Bechtel's construction responsibility is being carried out through a newly formed Norwegian company, A/S Bechtel-Sverdrup, Norge. Major buildings, general site preparation, and grading work were handled independently by various Norwegian firms.

The detailed engineering and construction of the marine terminal was awarded to the Royal Netherlands Harbor Works. The detailed engineering was done in Amsterdam. Dutch supervision and Norwegian labor have carried out the construction program.

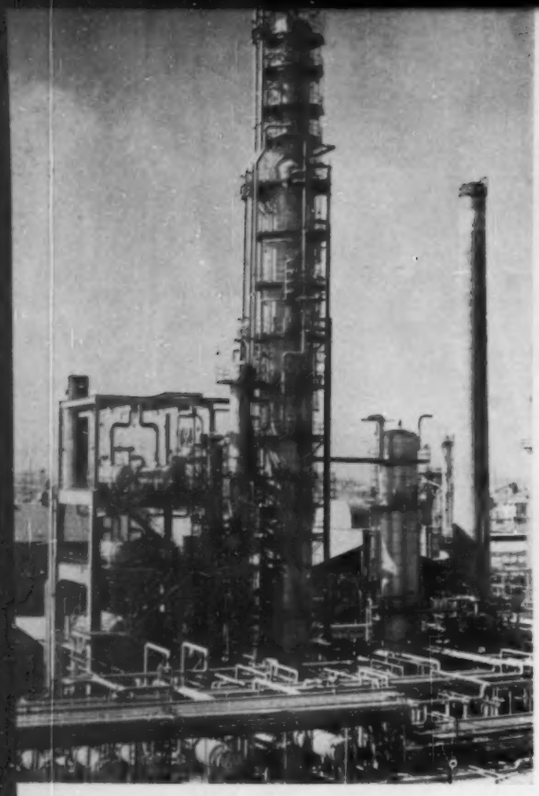
The contract for the refinery tankage was awarded to an American firm, the Graver Tank & Manufacturing Co,. on the basis of competitive bids solicited from over half a dozen countries. It is interesting to note that the tank plate, all of which originated in Japan, was delivered to Norway in one shipment. Fabrication and erection was done under Graver's supervision utilizing the personnel and shop facilities of Marinens Hovedverft, a Norwegian firm that operates a nearby shipyard.

Purchasing, too, was handled on an international basis. This was made possible largely through the cooperation of the experienced purchasing and shipping organizations of the various Esso affiliates. By obtaining competitive bids on the world market, advantage was taken of the best possible prices and deliveries for the refinery materials. As a result, materials and equipment are being supplied from eleven different countries. Norway, Italy, and the United Kingdom head the list of major supply sources, followed by Germany, the United States, and The Netherlands.

This project has supplied new opportunities to Norwegian industry and labor. They have provided a large share of the goods, services, and manpower necessary to make the refinery a reality. When the refinery goes into operation, it will be a source of stable new jobs for the Norwegian people. At the same time, a substantial saving of Norway's foreign currencies will result since the refining costs associated with petroleum products will then be incurred and paid for in local currency. Further, the building of this refinery has provided a valuable opportunity for people of different national backgrounds to work together in an atmosphere of mutual responsibility, respect, and benefit. END

Computers Cut Costs

"A typical example of the savings realized by using computers as engineering aids may be seen in the Esso refinery now under construction at Slagen, Norway. Much of this plant was designed with the help of computer programs that estimated costs and solved problems in process planning and mechanical design. A program to stimulate marine terminal operations cut costs of piping, pumps and docking facilities. Even the strain on ships' hawsers under varying conditions of wind and tide was calculated in order to develop the best mooring system at the lowest price. The saving in engineering man-hours and the reduction in equipment cost at Slagen amounted to nearly a half million dollars."—*The Lamp*, Summer 1960. Standard Oil Co. (New Jersey).



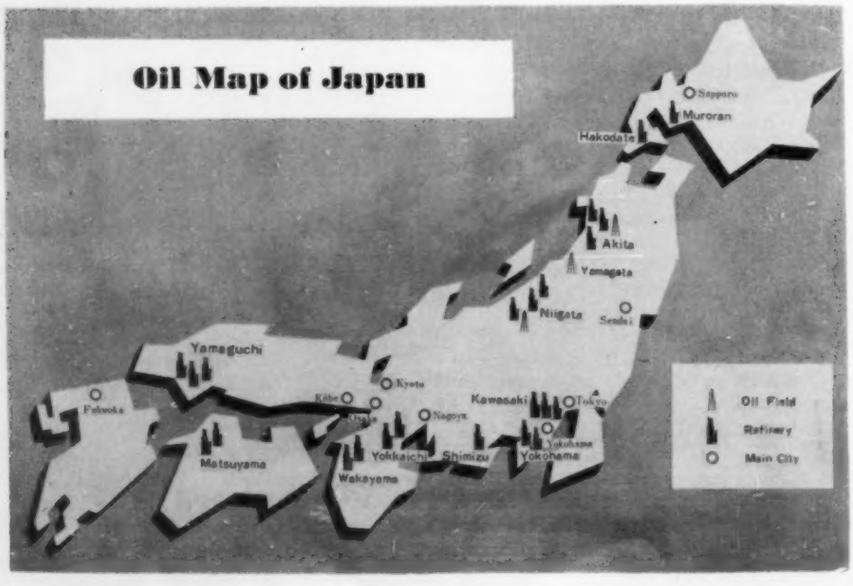
Vivid demonstration of heavy automobile traffic—a rush-hour traffic condition in downtown Tokyo at Sukiyabashi Street near Ginza.

Highest topping tower in Japan—the No. 2 unit at Mitsubishi Oil Co. Ltd.

Japan's refining—640,000 b/d this year—continues its steep rise

by Masaya Ishii*

Fast growing economy of the nation has helped to boost petroleum demand 100-fold during the past 15 years



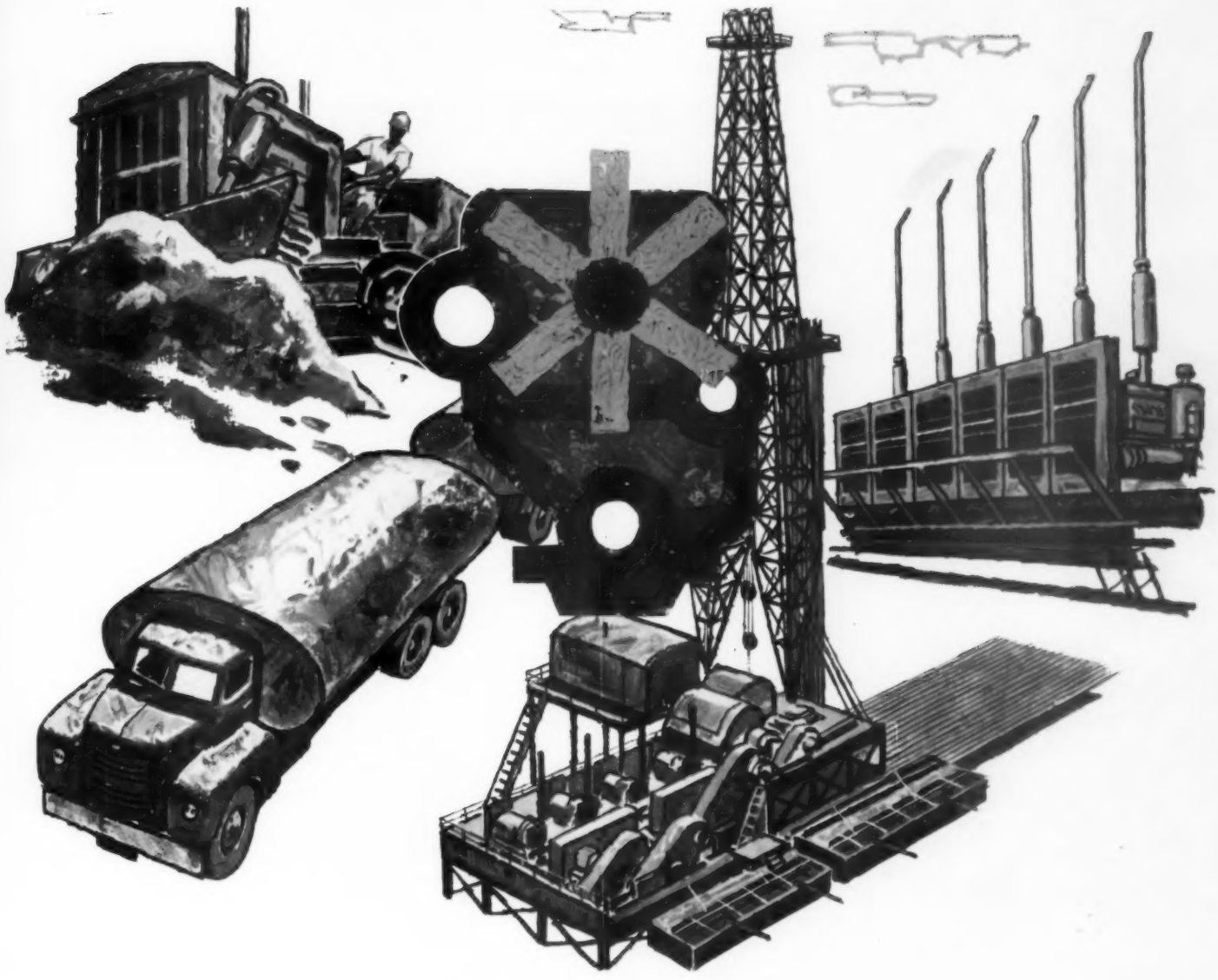
PETROLEUM DEMAND in Japan has risen 100-fold in the last 15 years, from 1.6 million barrels in 1945 to an estimated more than 160 million barrels in 1960. This remarkably rapid growth in demand after World War II resulted, in part of course, on the recovery from a demand that had been reduced unnaturally during the war. Before the war, the peak demand for oil products in Japan was the 31.5 million barrel figure of 1937. No further growth was expected once demand reached the pre-war level of 34 million barrels in 1952. Yet eight years after, in 1960, it had increased about 500%.

The rapid growth of Japanese economy since World War II brought a rapid increase of production and consumption in every industry, but no other industry seems to have shown such remarkable growth year by year as oil.

Although the rise in demand was distributed widely throughout Japan, it was concentrated in three large cities—Tokyo, Osaka and Nagoya—and their surrounding areas, which accounted for more than 60% of all Japanese demand.

Although the population of Tokyo is 10% of Japan's total, the city's oil demand is 20% of the nation's total. With its surrounding prefectures (Kanagawa, Chiba

*Mr. Ishii is chief, market research section, Mitsubishi Oil Co. Ltd., Tokyo.



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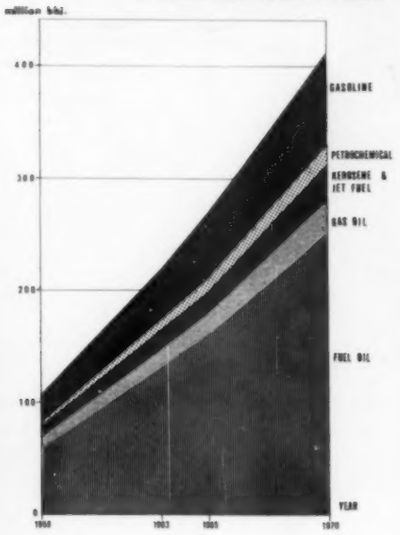
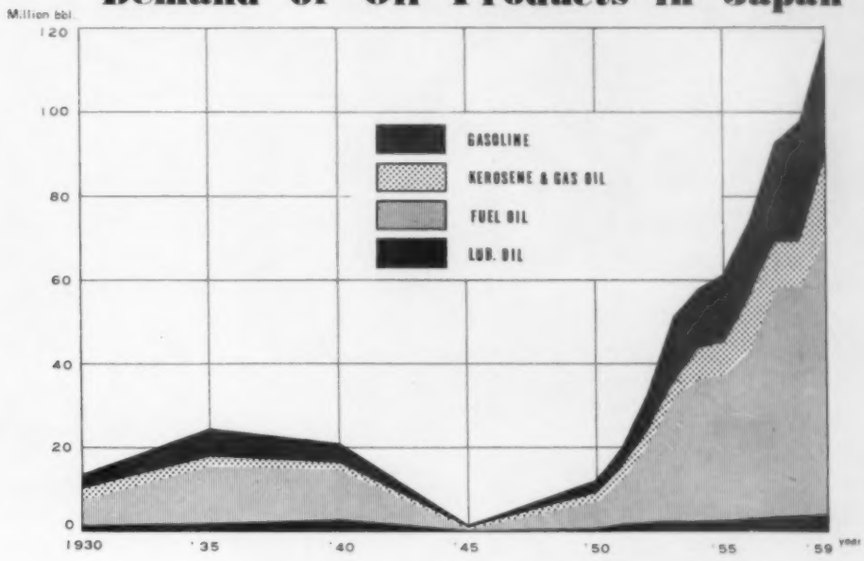
Japan Petroleum Demand Forecast



Demand of Oil Products in Japan



and Saitama), Tokyo represents about 30% of demand and it continues to rise. Osaka city is smaller than Tokyo, but Osaka prefecture, including its satellite cities, has 14% of demand; furthermore, with the neighboring Hyogo and Kyoto prefectures, this figure reaches over 20%. Aichi prefecture, including Nagoya city and with neighboring Shizuoka and Mie prefectures, is 13% of all Japan. Fukuoka prefecture, including Fukuoka city and such other industrial areas as Yawata and Kurosaki, shows more than 5% of all Japan. No other prefecture mentioned above has more than 3% of the demand.

Demand is concentrated in the industrial areas because industry is the major consumer in comparison with agriculture, mining, or home use in Japan. See Table 1.

For this reason, trends in product demand differ markedly from the USA, for example. Fuel oil demand now represents over half the total, and gasoline only about one quarter the total in Japan. As noted later, there is no large growth expected in other energy supply, consequently the trend in fuel oil use will probably continue.

The trend in petroleum supply is shown in Table 2. In 1930, domestic crude, at about 2 million bbl, supplied over 14% of total demand, some 14 million bbl. However, demand rose so rapidly that by 1959, domestic crude—at 2.9 million bbl—supplied less than 2% of the total demand, 147 million bbl.

Crude production in Japan has not changed greatly during the past 50 years. Although it was reduced during and just after World War II, it recovered the highest pre-war level since last year. Various efforts of searching for oil have been taking effect recently; however, demand expansion is so great that little change in the ratio of supply to demand can be expected. Crude oil is produced mostly in Akita, Niigata and Yamagata prefectures. Production from other areas is negligible.

Demand in Japan has been chiefly supplied by imports. Before 1930, petroleum had been generally imported as products, but since that time, more and more crude oil has been imported and refined locally. Restoration of refining in Japan after the war brought a rapid increase in the crude oil imports ratio. Today, only low sulfur fuel oils and lube oils are imported as products; they are less than 10% of crude imports.

Both crude and products were imported from the USA before the war, but because the USA became an importer after the war, Japan began to rely upon the Middle East as its source of crude, like other European countries. Today, imports from the Middle East reach more than 80% of the total imported crude oil. See Table 3.

Refining. Oils were discovered very early in Japan. It was written in the historical book that burning-water was served to the Emperor in 668. The refining of oil was begun more than 100 years before, according to other historical books. However, modern type refiners as known today began to operate around 1930. Before that time, there were some small-scale refineries for the domestic crude.

With the growth in crude oil imports after the war, the number of operating refineries and their capacities grew rapidly. In 1944, Japan's refining capacity was 72,000 b/d. It was reduced to 19,200 b/d by the bombing at the end of 1945, but at the end of 1950 it had risen to 68,700 b/d and it has been increasing year by year, until it reached 640,000 b/d at present. Details on Japan's refineries can be found in the survey elsewhere in this issue.

The percentage of gasoline demand to total demand in Japan is not as large as that in the USA, but it is still large next to fuel oil. Of course, it serves chiefly motoring—more than 95%. The balance of the market is for aviation, industry and agriculture.

The rapid increase of automobiles in Japan, especially in the large cities, has been remarkable. The trend of automobile registrations in Japan is shown in Table 4.

Recently owner-drivers have been increasing in Japan and for the purpose, a large number of compact cars are being produced domestically. It has become fashionable among Japanese young people to get driving licenses.

But the big factor to prevent the increase of motor-cars is the condition of Japan's

TABLE 1—SALES OF JAPAN'S PETROLEUM PRODUCTS TO CONSUMERS BY INDUSTRIES, 1958
(In 1,000 bbl)

	Gasoline	Kerosine	Gas Oil	Fuel Oil	Lube Oil	Total
Agriculture, Forestry and Hunting	1,144	1,304	230	245	102	3,025
Fishery	81	241	306	7,939	368	8,935
Mining	409	74	140	449	98	1,170
Construction	1,444	160	491	287	123	2,505
Manufacturing	3,531	1,618	663	30,694	1,385	37,891
Transportation and Communication	11,527	540	4,612	6,851	933	24,463
Electricity & Gas	187	10	120	7,581	66	7,964
Other Public Utilities	6,471	3,683	930	2,366	477	13,927
Total	24,794	7,630	7,492	56,412	3,552	99,880

TABLE 2—PETROLEUM SUPPLY IN JAPAN, 1930-1959
(In 1,000 bbl)

	Crude			Products		
	Domestics	Imports	Total	Domestic Ref.	Imports	Total
1930	1,994	3,585	5,579	4,529	9,529	14,058
1935	2,208	8,378	10,586	9,356	18,310	27,846
1940	2,082	14,417	16,499	10,391	12,089	22,480
1945	1,560	——	1,560	1,629	157	1,786
1950	2,069	9,693	11,762	10,473	5,309	15,782
1955	2,233	53,798	56,031	54,182	15,008	69,190
1956	2,202	71,945	74,147	74,279	11,951	86,230
1957	2,270	93,300	95,570	91,526	21,556	113,082
1958	2,579	102,596	105,175	100,131	12,492	112,623
1959	2,855	135,034	137,889	135,474	11,618	147,092

Note: Figures do not agree with demand statistics owing to loss or refinery use.

TABLE 3—JAPAN'S CRUDE IMPORTS BY COUNTRIES
(In 1,000 bbl)

		1956	%	1959	%
Middle East	Arabian	34,935	(48.6)	27 437	(20.3)
	Kuwait	9,209	(12.6)	42.395	(31.4)
	Iran	3,906	(5.4)	7,705	(5.7)
	Iraq	3,937	(5.5)	18,637	(13.8)
	Wafra	4,554	(6.3)	6,498	(4.8)
	Others	421	(0.6)	9,919	(7.4)
	Total	56,962	(79.2)	112,591	(83.4)
British Borneo	Seria	7,253	(10.0)	6,447	(4.8)
Sumatra	Minas	4,403	(6.1)	3,680	(2.7)
	Northern Sumatra	793	(1.1)	2 453	(1.8)
	Lilic	—	(—)	1,283	(0.9)
	Duri	—	(—)	3,931	(2.9)
	Others	283	(0.4)	1,912	(1.4)
	Total	5,479	(7.6)	13,159	(9.7)
New Guinea	Klamono	1,113	(1.5)	579	(0.4)
U.S.A.	San Joaquin	623	(0.8)	1,308	(0.9)
	Coalinga	289	(0.5)	233	(0.2)
	Total	912	(1.3)	1,541	(1.1)
South America	Venezuela	—	(—)	101	(0.1)
Canada	Pembina	113	(0.2)	—	(—)
	Leduc	113	(0.2)	—	(—)
	Total	226	(0.4)	—	(—)
U.S.S.R.	Northern Sakhalin	—	(—)	245	(0.2)
	Second Baku	—	(—)	371	(0.3)
	Total	—	(—)	616	(0.5)
	Grand Total	71,945	(100.0)	135,034	(100.0)

TABLE 4—NUMBER OF MOTOR VEHICLES IN JAPAN, 1938-1959
(In 1,000's at Year-end)

	Passenger Cars	Trucks	Buses	Others	Trucks—3-Wheel	Motor Bicycles	Total
1938	59	68	24	4	51	16	222
1945	25	73	13	2	29	2	144
1946	27	84	12	7	34	3	167
1947	26	100	13	11	38		188
1948	30	122	15	14	57		238
1949	36	138	16	16	106		312
1950	43	151	18	17	112	47	388
1951	58	169	21	19	153	83	503
1952	88	191	24	22	213	177	715
1953	115	213	28	27	294	349	1,026
1954	138	235	32	35	367	505	1,312
1955	154	250	34	36	429	561	1,464
1956	181	294	38	44	494	668	1,719
1957	218	372	43	53	554	777	2,017
1958	260	455	47	61	612	897	2,332
1959	307	559	51	69	724	1,010	2,720

TABLE 5—JAPAN'S FUEL OIL DEMAND BY USES, 1955-1959
(In 1,000 bbls)

	1955	1956	1957	1958	1959*
Electricity	2,000	3,800	7,900	6,400	9,300
Gas	1,000	1,400	1,000	1,100	700
Mining & Manufacturing	24,000	28,700	33,500	36,300	48,200
Water Transportation	4,100	5,400	6,800	6,500	7,000
Agriculture, Forestry & Fishery	6,500	8,000	8,300	8,200	10,000
Others	2,000	2,200	2,500	3,200	3,900
Total	39,600	49,500	60,000	61,700	79,100

* Estimation

roads. Visitors from other countries describe Japanese roads quite simply, "narrow and unpaved." Road improvement in Japan has been extraordinarily delayed compared with other countries. Till 1958, even the first class national road, the main road in Japan, had been paved only 34%, and only 2% of all roads in Japan had been paved. By comparison, 31% of all USA and 26% of all Italy's roads are paved.

With the rapid growth in economic development, the transportation demand increased remarkably. The Japanese government has felt keenly the urgent necessity for road improvements. Even a "five-year plan" for highway development decided upon by the government would seem inadequate to satisfy the explosive growth in demand for better transportation facilities.

As can be seen in the picture, "traffic jams" are common in the cities, and especially in the center of Tokyo to walk on foot seems to be faster than to go by car at "rush-hour," so the hurried people take the subway.

Fuel oil demand has been concentrated to industrial uses, especially a large expansion for electricity. (See Table 5.) It has depended upon the energy supply in Japan.

At present, production industries are supported greatly by energy, not by labor. This trend will be emphasized even more with the increase in automation.

Japan's energy supply has also grown in parallel with the growth in national income, as shown in Table 6.

But Japan does not have enough energy sources. In truth it has much coal and water power considering its narrow country, yet this is not sufficient to ensure enough national income for its large population. Nowadays, as the mining costs have been rising it seems to be more economical to reduce coal production and to produce only from excellent mines. More development of water power will not be expected by geographical reasons and the loss in transmitting. For these reasons, only oil will support the increasing demand and fuel oil will take the place of coal and water power, before atomic power will be supplied economically. Thus, fuel oil consumption will continue to increase in the future. See Table 7.

Petroleum demand in future. What will be the future petroleum demand in Japan? It will be unnecessary to revise the estimation of gasoline demand given in WORLD PETROLEUM, July 1958, but the demand of kerosine and gas oil will be sharply increased over the estimation at that time. This is because the increased gasoline taxes have distorted the structure of oil demand and use of diesel motor vehicles has increased for long distance transportation.

As mentioned above, fuel oil demand will be the most influential on the future total demand.

On Feb. 25, 1960, the Japan Petroleum Association estimated the total petroleum demand in 1970 to be about 420 million barrels, as shown in the accompanying chart. However, a month later, the electric industry said that the estimate of fuel oil demand for electricity was too small. Actually the demand of this year is estimated to exceed far beyond that line.

Recently, the Economic Planning Board estimated petroleum demand as follows (in million bbl):

	1970	1980
Gasoline	84.6	161.6
Petrochemical	12.6	12.6
Jet Fuel & Kerosine	30.5	52.5
Gas Oil	33.2	67.4
Fuel Oil	268.5	519.9
Total	429.4	814.0

This estimate is not so different for 1970, as compared with that by the Petroleum Association.

What is most likely is that all such forecasts are conservative, as has been the case in predictions of world demand. END

TABLE 6—TREND OF NATIONAL INCOME & ENERGY SUPPLY IN JAPAN

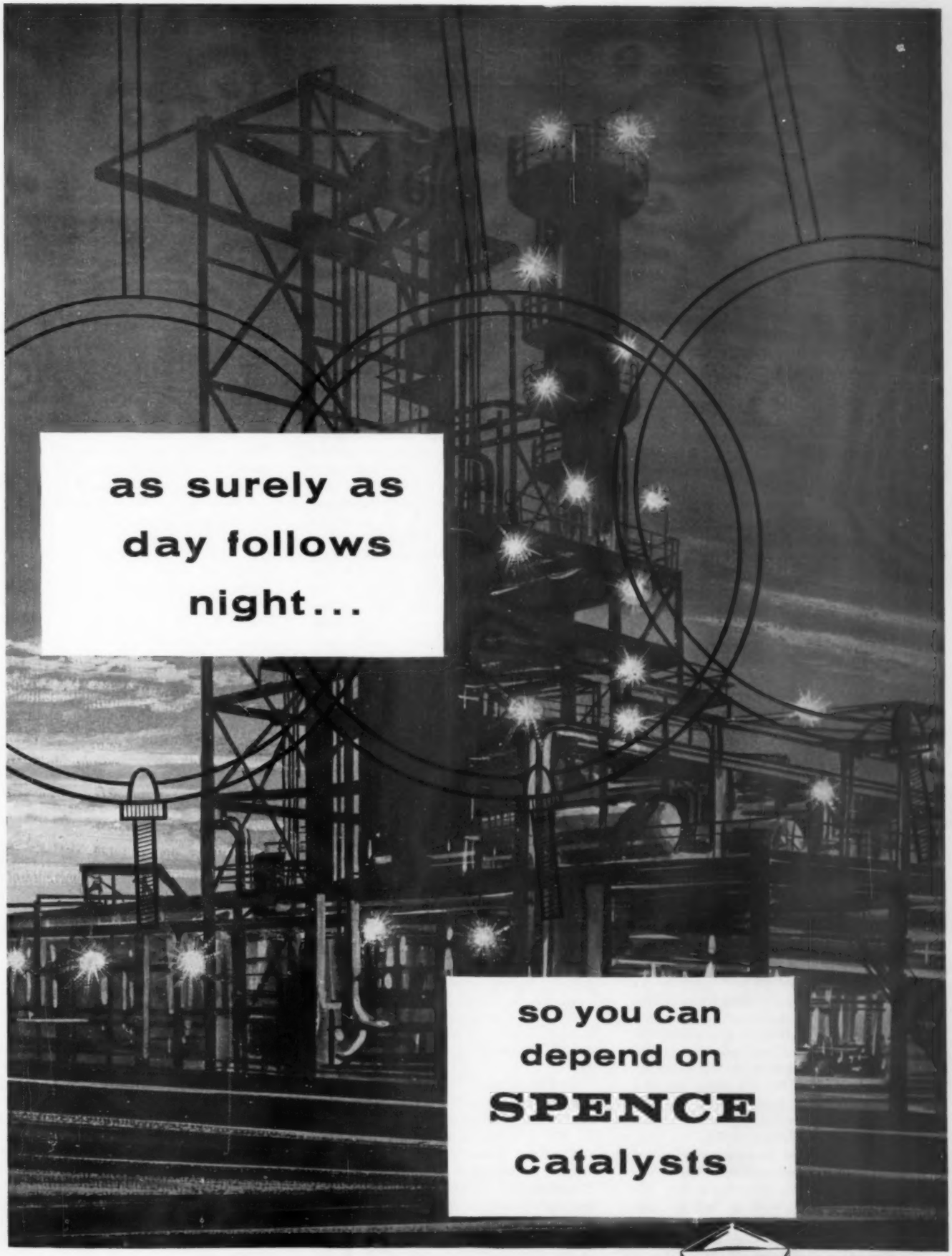
	National Income*	Energy Supply**
1900	1.73	25.67
05	1.49	21.43
10	1.91	25.49
15	2.27	29.44
20	2.64	40.90
25	3.88	45.20
30	4.12	56.52
35	4.81	73.86
40	5.41	105.76
46	2.77	51.89
47	2.96	64.48
48	3.42	68.27
49	3.95	74.01
50	4.71	78.97
51	5.11	86.62
52	5.58	91.54
53	6.03	102.65
54	6.16	101.55
55	6.68	103.55
56	7.62	115.77
57	8.04	123.59
58	8.40	123.16

* Based on 1956 values, in one trillion yens.
** In one billion therms.

TABLE 7—ENERGY SUPPLY IN JAPAN
(Thousand metric tons coal equivalent)

	Coal	Petroleum	Water Power	Wood	Total
1891	2.720	—	—	12.580	15.300
1905	9.925	306	40	10.670	20.941
1920	25.191	546	1.980	11.760	39.477
1930	30.250	3.483	8.060	12.400	54.193
1940	59.329	6.570	14.600	20.610	101.109
1955	41.635	17.284	29.130	11.000	99.049
1956	47.878	21.578	31.570	11.000	112.026
1957	53.443	26.835	32.302	11.000	123.580
1958	50.420	27.150	34.590	11.000	123.160
1962*	71.105	42.379	39.600	11.000	165.000
1975*	93.228	92.080	58.100	11.000	276.000**

* The figures of 1962 and 1975 were estimated by the Economic Planning Board several years ago. Total energy demand can be expected to go even higher and coal supply will remain at 50 million tons level. Thus, the petroleum supply should be increased far beyond the above figures.
** Includes nuclear fuel.



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Annual review of USA patents on petroleum refining and processing

by Heinz Heinemann and P. A. Lefrancois

PERHAPS THE MOST significant trend in the more than 500 patents evaluated for this year's review is the increasing emphasis on feed preparation and on processes converting crude oil fractions to products other than gasoline.

With very few exceptions, most of the patents reviewed deal with improvements to well-known processes. Cracking, reforming, desulfurization, alkylation, and other techniques are being worked on continually by the petroleum research laboratories.

Most of the new patents dealing with catalysts were discussed in a previous review (WORLD PETROLEUM, March, 1960, pp. 72-74), and are not covered again here. An attempt has been made to select patents for this review which appeared to the authors to be typical of trends or sufficiently novel to be of general interest. The necessarily arbitrary nature of such a selection is recognized.

CATALYTIC REFORMING. Just as in the preceding years, this category includes the largest group of patents issued this year. Those treated here are processing patents. Those on catalysts were digested in the review in March mentioned above. If these were added to the processing patents, the total number would be almost twice as large. Perusal of the new patents makes it obvious that the field has reached maturity. Very few patents cover broad areas. Most are concerned with processing improvements of value to the refiner under specific circumstances.

Feed preparation is the subject of one small group of patents. R. L. Hardy (2,876,194 to Esso Res. & Eng. Co.) adds 0.5-5 mol-% water (based on hydrogen) to the feed to a fluid bed molybdena hydroformer. This keeps the molybdenum in a higher valence state. A. B. Welty in Esso's 2,898,287 desulfurizes naphtha feed prior to reforming. C. E. Hemminger, A. B. Welty and W. O. Taff in Esso's 2,901,415 adjust the feed to 0.001% S, 1-10 ppm halogen and 5-20 ppm water before reforming over platinum alumina. R. C. Morbeck (2,904,501) fractionates the pentene fraction out of a cat cracked naphtha and combines it with virgin naphtha to get a reformer charge. Nitrogen compounds, such as pyridine, are added in 2-200 ppm concentration to naphtha feed in accordance with Universal Oil Products Co.'s 2,906,699 (V. Haensel and G. R. Donaldson) to suppress hydrocracking. J. M. Brooke and F. E. Gilmore (2,917,452 to Phillips Petroleum Co.) decrease corrosion during reforming by performing a two stage desulfurization.

The following patents are characteristic of a group dealing with reformer startup procedures. W. P. Burton and C. E. Slyngstad (2,902,434 to M. W. Kellogg Co.) pass inert gas over the catalyst at dehydrogenation temperature and introduce naphtha with the inert gas until the hydrogen concentration is sufficient for reforming and then adjust operating conditions for reforming. H. A. Holcomb and R. M. Love (2,898,291 to Esso Res. & Eng. Co.) disclose a startup procedure, using methane, while T. M. Moore and H. I. Weck in two Standard Oil Co. (Ind.) patents (2,889,161 and 2,880,162) use flue gas. An inert gas, followed by methane, is also proposed in Standard Oil Co.'s (Ind.) 2,910,430 (J. A. Bock, R. J. McDaniel and D. W. Schubert).

Quite a few patents are concerned with design. Typical are: a twin reactor design, proposed by R. T. Kyle and A. Nilsen (2,921,845 to Gas Machinery Co.); a fluid bed reactor claimed by M. F. Nathan (2,899,284 to M. W. Kellogg Co.); a fluid bed unit, employing inactive metal shot for heat balance control, as disclosed in Esso Res. & Eng. Co.'s 2,898,290 (L. E. Swabb); and a unit in which thermal cracking is minimized by special furnace design, controlling soaking time (K. M. Elliott to Socony-Mobil Oil Co., 2,886,516).

The bulk of reforming patents deals with operational features. J. B. Malloy, for instance, in 2,916,433 to Standard Oil Co. (Ind.) fractionates reformate between the second and third reactor and charges only material boiling below 300 F. to the third stage. K. S. Cuddington and J. Mather (2,921,016 to Standard Oil Co., Ind.) subject reformate to a mild hydrogenation to stabilize it against deterioration by light and air.

An Esso patent (2,908,636 F. W. Steffgen and C. N. Kimberlin) discloses a cyclic operation with fluid platinum type catalyst going first to a regeneration, then to a halogen treating zone before returning to the reactor. In the same company's 2,885,345, Hemminger, R. H. Dudley and R. B. Long describe feeding a volatile chlorine compound to the second stage of a reformer.

Heat balance problems are treated in two M. W. Kellogg Co. patents. M. R. Smith (2,883,335) removes a portion of the catalyst from the endothermic zone, raises the catalyst temperature by burning combustibles, and recycles the hot catalyst to the endothermic zone. C. E. Slyngstad and J. L. Patton (2,915,458) operate a first reactor with a heated bed, so that the outlet temperature is 25-200 F higher than the inlet and pass the effluent to an adiabatic second bed. W. H. Dennis (2,917,454 to Phillips Petroleum Co.) controls the extent of hydrocracking during reforming by adding either water or halogen compounds to the feed.

Numerous methods of improving reformate by separation or extraction techniques are described. E. R. Christensen and H. V. Hess (2,888,394 to Texaco) treat a reformate boiling below 250 F with molecular sieves to remove straight chain hydrocarbons. C. Bednars, M. R. Smith and G. W. Stanford, in M. W. Kellogg Co.'s 2,881,128, recover gasoline hydrocarbons from gaseous reformer effluent by absorption in naphtha. C. K. Donnell, R. M. Kennedy and A. Schneider (2,890,994 to Sun Oil Co.) disclose a dual reforming process with fractionation to give blended gasoline of balanced volatility. R. D. Bauer and N. W. Mitchell in Phillips Petroleum Co.'s 2,905,621 fractionate reformate into low and high boiling fractions and re-reform the low boiling part. In a British Petroleum Co. patent (2,897,132; W. N. N. Knight) catalytic reformate is fractionated and high and low boiling fractions are separately thermally reformed. In one of two Standard Oil Co. (Ind.) patents, B. L. Evering and A. K. Roebuck (2,918,422) split naphtha into a lower boiling fraction, which is reformed with chromia-alumina and a higher boiling fraction, which is reformed with platinum-alumina. In the other patent (2,877,173) H. C. Thorne and H. M. Belkin extract a reformate with a glycolic solvent and recycle the raffinate to the reformer. A Shell Dev. Co. patent (2,921,015; R. N. Shiras) gives procedures for producing light and heavy aromatic concentrates from reformates by extraction.

Solvent extraction is also disclosed in three Universal Oil Products Co. patents. V. Haensel and G. R. Donaldson in 2,915,453 solvent extract reformate, fractionate the raffinate, recycle a light fraction to the second and a heavy fraction to the first stage of the reformer. In Donaldson's 2,915,454 and 2,915,455 the light raffinate is thermally reformed.

C. E. Hemminger in Esso's 2,885,347 fractionates n-pentane from reformate and

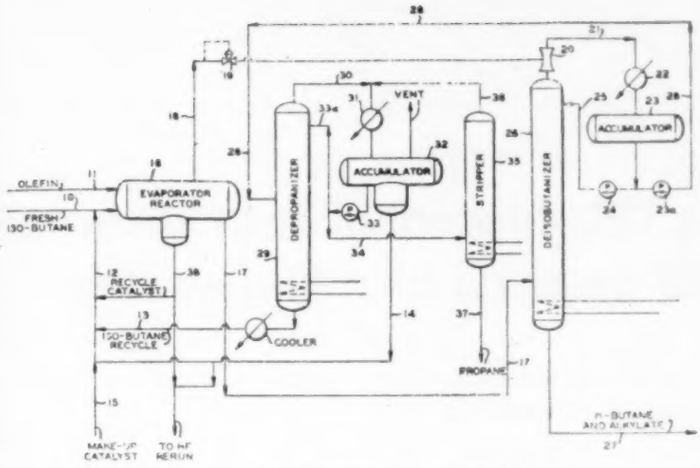


Fig. 1—Alkylation system: USA Patent 2,894,999, S. D. Lawson (to Phillips Petroleum Co.)

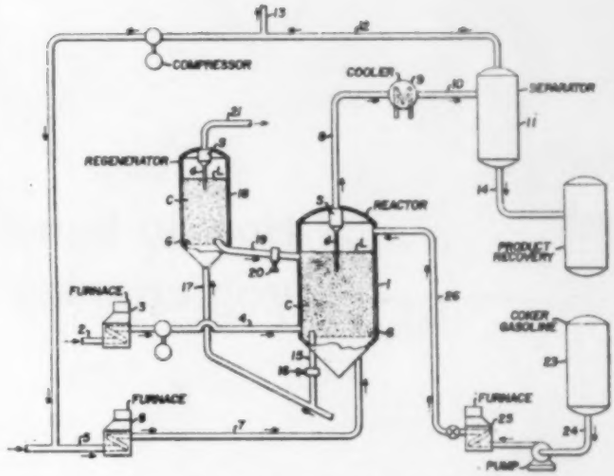


Fig. 2—Simultaneous reforming and desulfurization: USA Patent 2,916,434, K. E. Draeger and L. A. Nicolai (to Esso Research and Engineering Co.)

recycles it to the reformer. In the same company's 2,889,263, Hemminger and D. D. Dunlop hydroform with hydrocracking of recycle paraffins.

Combinations of reforming and other processing are discussed in quite a few patents, of which the following are typical. V. Haensel and G. R. Donaldson (2,906,691 to Universal Oil Products Co.) describe a combination of catalytic reforming, alkylation and solvent extraction. According to Donaldson's 2,891,901 (to Universal Oil Products Co.) cat reformate is sent to a thermal reformer; the product is solvent extracted and the paraffinic fraction returned to reforming. A. Schneider and C. K. Donnell (2,908,628 to Sun Oil Co.) dehydrogenate naphtha over a platinum catalyst, separate product into aromatic and paraffin rich fractions and hydrocrack the latter. C. L. Thomas (2,908,629 to Sun Oil Co.) catalytically cracks a reformate at conditions which do not demethylate aromatics. A Standard Oil Co. (Ind.) patent 2,911,352 (L. A. Goretta and M. J. Den Herder) discloses combinations of reforming cracking and solvent extraction. S. D. Lawson (2,890,163 to Phillips Petroleum Co.) reforms naphtha over platinum catalyst, then cracks the effluent over bauxite to get olefins. D. K. Beavon (2,920,033 to Texaco), discusses utilization of reformer hydrogen for motor fuel hydrogenation. R. A. Finellay (2,890,995 to Phillips Petroleum Co.) reforms a feed containing alkylate.

The last group of patents to be discussed here comprises miscellaneous reforming procedures. A. M. Thomas and R. L. Weeks (2,910,428 to Esso Res. & Eng. Co.) disclose a procedure of thermal reforming in the presence of steam. P. S. Viles in another Esso patent (2,900,427) contacts light paraffinic hydrocarbons with sulfur dioxide and cobalt molybdena catalyst to product aromatics. A. M. Henke in Gulf Res. & Dev. Co.'s 2,909,480 burns part of the reformer recycle gas and introduces the hot gas into the reformer to maintain temperature. P. W. Garbo and F. B. Grosselfinger (2,906,696 to Hydrocarbon Research Corp.) reform naphtha and hydrogen over unpromoted active carbon at 900-1075 F and 250-600 psig, and regenerate the carbon with steam at 1600-2200 F.

HYDROGENATION AND DEHYDROGENATION reactions are part of catalytic reforming, desulfurization and hydroisomerization reactions. There are, however, a few dozen patents which cannot be fitted into these categories and refer to saturation or production of olefinic compounds, hydrogenation of cycle stocks, etc. These are treated here.

D. F. Hill (2,899,383 to Socony-Mobil Oil Co.) restores the activity of a declining cobalt molybdena catalyst by increasing the amount of liquid feed charged to the catalyst. Washing of the catalyst as a means to extend its useful life is also disclosed by H. R. Pichler in 2,910,433 (to Hydrocarbon Res. Corp.). Gas oil hydrogenation and hydrocracking are the subject of two Pure Oil Co. patents. In 2,878,179 H. Hennig discloses a system of multiple reaction zones in which to carry out hydrogenation. H. O. Folkins and K. E. Lucas in 2,903,413 employ a cobalt nickel on silica alumina catalyst for hydrocracking. Hydrogenation of a mixed feed of fuel oil and catalytically cracked gasoline is described by H. Beuther, W. A. Horne and C. W. Montgomery in Gulf Res. & Dev. Co.'s 2,904,500.

J. W. Teter (2,898,387 to Sinclair Refining Co.) utilizes a platinum-alumina catalyst of high area and large pore diameter for the hydrogenation of benzene, ethylbenzene and C_6 petroleum cuts.

A dual reactor processing scheme for hydrocarbon hydrogenation is discussed in Esso Res. & Eng. Co.'s 2,882,216 (P. S. Viles). C. E. Hemminger, according to the same company's 2,914,462, carries out slurry phase hydrogenations in a reatcor which is expanded at the top. A method for hydropurification of petroleum oils is given in D. D. McLaren's 2,912,374 (to Esso). Catalyst shot is countercurrently contacted with oil and hydrogen.

Most dehydrogenation patents deal with diolefin or acetylene production. M. J. Hogsed (2,925,451 to du Pont) converts propylene and isobutylene to allene and methylacetylene over a metallic filament at 900-1600 C and low pressure. H. Heinemann, T. H. Milliken and D. H. Stevenson in Houdry Process Corp.'s 2,900,429 disclose a method of making isoprene from mixed C_5 hydrocarbons. An improved catalyst for the steam dehydrogenation of butenes to butadiene is claimed by W. E. Armstrong and C. Z. Morgan (2,916,531 to Shell Dev. Co.). Another Shell patent (2,921,102; M. C. Lowman) describes a reactor for contacting hydrocarbons with catalyst and an inert heat carrier. A. D. Green in Esso Res. & Eng. Co.'s 2,889,383 dehydrogenates C_4 and C_5 hydrocarbons in a vertical transfer line reactor. Improved dehydrogenation of n-butenes to butadiene-1,3 by close control

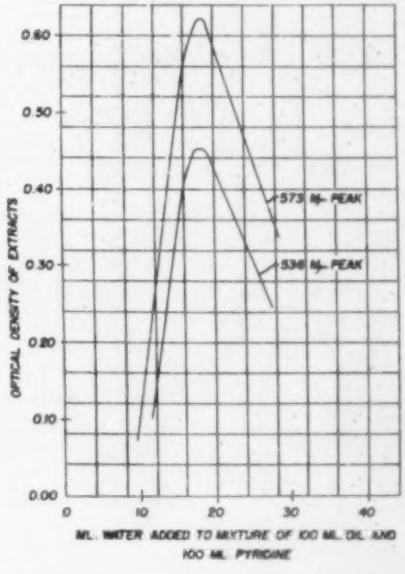


Fig. 3—Metals removal with pyridine: USA Patent 2,922,760, L. K. Beach and J. E. Shewmaker (to Esso Research and Engineering Co.)

How to handle TEL susceptibility in linear programming of gasoline blending studies

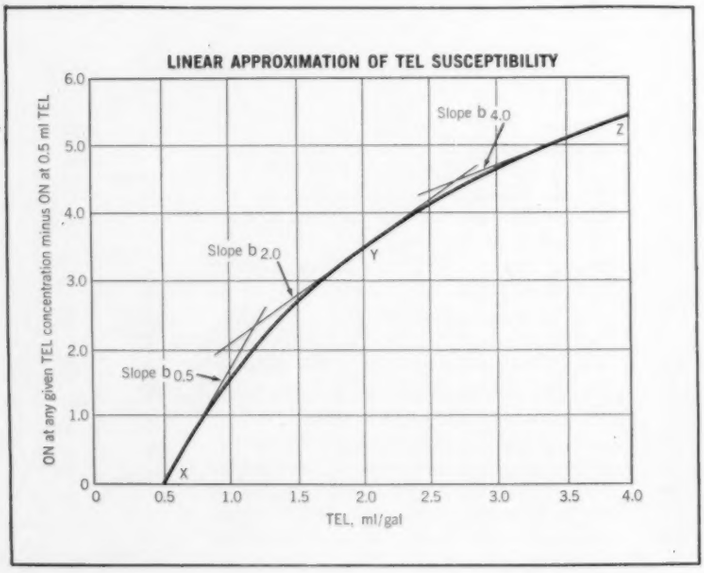
By Dr. W. C. Healy, Jr., Supervisor of the Computation and Economics Section, Refinery Technology Division, Ethyl Research Laboratories

In past years, gasoline blending was comparatively simple. An engineer could establish optimum blends for two grades of gasoline by using a slide rule and a TEL response chart.

Today gasoline blending and establishing maximum antiknock effectiveness are much more complex. Many components are used to make numerous grades of gasoline. Often, market conditions divert some gasoline component to another product. All this presents the refiner with a giant-sized problem of blending for maximum profit.

The magnitude of the problem has forced the refiner to electronic computer solutions, using such techniques as linear programming.

Because TEL susceptibility is a non-linear function, it presents a special problem for computer studies when linear programming is used. Many suggestions have been made for handling the TEL function, and one of the simplest recorded to date is outlined here.



The Ethyl method of handling the TEL function is similar to others in that a target TEL susceptibility curve is approximated by straight-line segments having fixed slopes. However, it is easier to use because—

A. No extra variables are introduced.

B. No extra upper-bounding conditions are required.

C. Set-up time is reduced.

Calculating TEL linear approximations is not difficult when final blend TEL susceptibility* is known. It becomes difficult when susceptibility is to be determined by computer. Calculations must employ approximated susceptibility values while retaining accuracy for reasonable deviations.

*TEL susceptibility is here defined as the difference between octane numbers at 4.0 ml. TEL/gallon and at 0.5 ml. TEL/gallon.

Here's How Ethyl's Method Works

For example, in the figure, three line segments are used to approximate the curve. The procedure is as follows:

A. Estimate a blend TEL susceptibility curve and then plot on rectangular coordinate paper.

B. Draw three approximating lines so that one line passes through point X (0.5, ON at 0.5), the second line passes through Y (2.0, ON at 2.0), and the third line passes through Z (4.0, ON at 4.0).

C. Determine the slopes of these approximating lines, $b_{0.5}$, $b_{2.0}$, and $b_{4.0}$, as shown on the accompanying chart.

Then the following inequalities are required; they state that the ml. TEL per gallon shall be no less than that required on any line segment, and no greater than 4.0.

1. $\text{TEL} \geq \frac{\text{ON (specification)} - \text{(ON at 0.5)}}{b_{0.5}} + 0.5$

2. $\text{TEL} \geq \frac{\text{ON (specification)} - \text{(ON at 2.0)}}{b_{2.0}} + 2.0$

3. $\text{TEL} \geq \frac{\text{ON (specification)} - \text{(ON at 4.0)}}{b_{4.0}} + 4.0$

4. $\text{TEL} \leq 4.0$

Let

$X_1, X_2 \cdots X_n$ = Barrels of each component in the blend.

ON_i at 0.5 = Corresponding octane blending values at 0.5 ml. TEL/gal.

ON_i at 2.0 = Corresponding octane blending values at 2.0 ml. TEL/gal.

ON_i at 4.0 = Corresponding octane blending values at 4.0 ml. TEL/gal.

And $Y = (\text{TEL})(\Sigma X_i)$

Ther substitute in 1, 2 and 3 above

$$\text{ON at } 0.5 = \frac{\Sigma X_i (ON_i \text{ at } 0.5)}{\Sigma X_i}$$

$$\text{ON at } 2.0 = \frac{\Sigma X_i (ON_i \text{ at } 2.0)}{\Sigma X_i}$$

$$\text{ON at } 4.0 = \frac{\Sigma X_i (ON_i \text{ at } 4.0)}{\Sigma X_i}$$

and multiply 4 by ΣX_i

These inequalities then reduce to the required linear expressions:

5. $\Sigma X_i (\text{ON spec} - ON_i \text{ at } 0.5 + 0.5\, b_{0.5}) - b_{0.5} Y \leq 0$

6. $\Sigma X_i (\text{ON spec} - ON_i \text{ at } 2.0 + 2.0\, b_{2.0}) - b_{2.0} Y \leq 0$

7. $\Sigma X_i (\text{ON spec} - ON_i \text{ at } 4.0 + 4.0\, b_{4.0}) - b_{4.0} Y \leq 0$

8. $Y - 4.0 \Sigma X_i \leq 0$

Under certain conditions the number of inequalities may be reduced to three or less.

Susceptibility Changes Are Compensated

Error-compensation is a built-in feature with this method since, when blend susceptibility varies (higher or lower) from the estimated value, the line segments adjust themselves to the proper portion of the new curve.

For greater accuracy, more than three line segments may be used to approximate the susceptibility curve. This requires additional analogous inequalities, but no additional variables.

Each additional octane specification calls for an estimated susceptibility curve and the statement of inequalities as shown above.

Checking the program before the computer run.

How Ethyl Research can help you

Ethyl Research has several years' experience with linear programming as it applies to gasoline blending. This background has been especially valuable for customer service work.

The new method of handling tetraethyllead susceptibility is one example of the professional assistance available to the refiner from Ethyl.

In addition, the Computation and Economics Section in our Refinery Technology Division will be glad to share its experience in computation techniques with your people.

For further information, ask your Ethyl Representative for a copy of "Two Approximation Problems in Linear Programming of Gasoline Blending" presented at the Computer Conference of the WPRA in Tulsa, December 1, 1959. He'll also be glad to arrange an appointment for you with one of our Mathematical Analysts.

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NEW USA REFINERY IN NEWEST STATE—Standard Oil Co. of California's new 35,000 b/d refinery on Oahu, about 20 miles west of Honolulu, Hawaii, being completed this year by Bechtel Corp.'s refinery and chemical division along with Hawaiian Dredging and Construction Co. Ltd. of Honolulu. View here shows main pipeway to crude unit terminating between the atmospheric and vacuum columns. At left is the stabilizer column for the crude unit.

of the temperature cycle is claimed in 2,884,473 (P. M. Resilly, E. P. Lewis and W. J. L. Kearns to Polymer Corp.).

ALKYLATION. There has been an increase in the number of alkylation patents since last year. It is too early, however, to judge whether this is fortuitous or signifies a trend toward larger interest in this subject.

The majority of alkylation patents deal with paraffin alkylation. K. J. Frech and R. C. Odioso (2,909,581 to Gulf Res. & Dev. Co.) alkylate a C_3-C_5 paraffin with a C_2-C_4 olefin using an organic peroxide as catalyst at 500-800 F and 500-10,000 psig. A two-stage sulfuric acid alkylation process is described by D. K. Beavon and F. H. Moore (2,906,797 to Texaco). The catalyst system employed by J. T. Kelly and H. M. Knight (2,898,390 to American Oil Co.) is composed of an alkyl hydrogen phosphate and boron trifluoride. Isobutane-olefin alkylation with an aluminum chloride catalyst in the presence of a mono-nuclear aromatic is proposed by A. K. Roebuck and B. L. Evering, 2,897,248 to Standard Oil Co. (Ind.). S. D. Lawson (2,894,999 to Phillips Petroleum Co.) discloses a modification of alkylation with HF. (See Fig. 1.) Mercaptans can act as catalyst promoters according to H. R. Davis and D. B. Brandon in M. W. Kellogg Co.'s 2,880,255. M. M. Wald and J. H. Raley (2,883,437 to Shell Dev. Co.) use a dihydrocarbylsulfide or hydrogen sulfide and free oxygen as alkylating agents. In Shell Dev. Co.'s 2,883,439, Wald employs a sulfhydryl compound as a catalyst and in 2,883,440, Raley elaborates on the use of a dihydrocarbyldisulfide.

Another group of patents deals with the alkylation of aromatics. L. Schmerling (2,883,324) in one of several Universal Oil Products Co. patents on the subject employs a catalyst comprising aluminum halide plus halogen-free titanium oxide plus alkali or alkaline earth metal. H. S. Bloch and G. L. Hervert (2,887,518; 2,887,519; 2,887,520) alkylate benzene with C_9-C_{18} olefins in the presence of sulfuric acid and an inert paraffin or halogenated paraffin. Schmerling and J. P. Luvisi (2,916,532) propose reacting benzene with a halogenated alkylating agent in the presence of metal aluminum hydride.

The alkylation of cumene and propylene over a steam treated silica-alumina cracking catalyst is discussed by A. de Keizer and J. N. Wilson in Shell Dev. Co.'s 2,897,246. Another process for the preparation of para diisopropylbenzene is disclosed in R. B. Egbert's 2,883,438 (to Mid-Century Corp.). H. G. Boynton and W. R. Edwards (2,896,001 to Esso Res. & Eng. Co.) add indan to alkylation reagents to prevent formation of stable phenomium ions. W. J. Mattox and W. F. Arey, Jr. (2,904,607 to Esso) employ a magnesium alumino silicate catalyst of 6-15 angstrom pore openings.

Equipment design for alkylation units is treated in several patents, such as C. G. Gerhold and R. E. Sutherland's 2,910,522 (to Universal Oil Products Co.) and M. W. Kellogg Co.'s 2,920,124 (S. R. Stiles, J. Warburton and J. M. Black) and 2,894,500 (S. R. Stiles).

A process for the thermal dealkylation of aromatics is claimed in Esso Res. & Eng. Co.'s 2,924,569 (A. M. Souby).

A method for regenerating alumina adsorbent, used in removing sulfur compounds from alkylate, is disclosed by S. R. Stiles in 2,920,125 (to M. W. Kellogg Co.). R. C. Binning and R. J. Lee (2,923,751 to American Oil Co.) have developed a method for separating a high octane fraction from alkylate by the use of a permeable membrane of cellulosic character.

ISOMERIZATION. There has been little change of trends in catalytic isomerization patents over the last few years. About two or three dozen patents issue per year, mostly dealing with precious metal catalysts and the isomerization of C_4 to C_6 paraffins. New features during the last year catalysts involve the use of molecular sieves and combinations of precious metals and Friedel-Crafts catalysts.

Texaco's 2,918,511 (N. D. Carter and H. V. Hess) describes the isomerization of a

C_6 fraction with a platinum catalyst. Dimethylbutanes are separated from the product by fractionation, n-hexane from methylpentanes by molecular sieve adsorption. L. Bleich, H. G. Codet and C. E. Hemminger in Esso Res. & Eng. Co.'s 2,909,582 and 2,909,583 contact C_5 and C_6 fractions with molecular sieves to separate straight chain paraffins, which are then isomerized with Friedel-Crafts type catalysts. Isomerizate is recycled to the sieves.

Isomerization is the subject of a group of Pure Oil Co. patents. According to N. L. Carr's 2,917,565 and 2,917,566, 2-8% nickel on a cracking catalyst base serves as catalyst for the isomerization of C_4-C_7 hydrocarbons at 600-750 F and 50-1000 psig. The same type of catalyst but with a group VIII noble metal promoter is employed in E. L. Miller and H. O. Folkin's 2,918,509. In 2,918,510 Carr, V. Brozowski and O. L. Beber use a nickel molybdate on silica-alumina catalyst and claim that the presence of water vapor prevents hydrocracking. Palladium and rhodium are the active catalyst components described in 2,925,453 by Folkin, Miller and K. E. Lucas.

Control of catalyst aging in isomerization is the subject of two Gulf Res. & Dev. Co. patents. W. C. Starnes and R. C. Zabor in 2,906,798 inject hydrogen into the reactor middle to maintain a H_2 concentration of 0.13 to 0.3 mol-%. An equation correlating temperature and hydrogen concentration required to inhibit aging is given in 2,910,-523 (C. W. Montgomery; W. C. Starnes; R. C. Zabor).

Universal Oil Products Co. has obtained several isomerization patents. H. S. Bloch and V. Haensel (2,900,425) employ a combination platinum-alumina and aluminum halide catalyst. Haensel in 2,908,735 discusses butane isomerization at 950 F over a platinum-alumina-halogen catalyst, while hexane isomerization with platinum-alumina-aluminum chloride is the subject of Haensel's 2,915,571. D. H. Belder (2,905,-736) isomerizes hexane over platinum catalysts, G. R. Donaldson (2,924,638; 2,924,-629) over aluminum halide on alumina.

A few patents deal with olefin isomerization. E. W. Pitzer in Phillips Petroleum Co.'s 2,921,103 prepares terminal bond olefins by double bond shift over a chromia on alpha alumina catalyst at 950-1300 F. M. R. Golub (2,878,176 to the B. F. Goodrich Co.) converts poly butadiene cis-1, 4 structures to trans-1, 4 structure by ultra violet radiation in a solution containing an organic bromide.

DESULFURIZATION. The number of patents in this area has sharply increased during the last year, although there are no apparent developments to justify this trend. Desulfurization is now the second largest subject treated in this review. The large number of patents can be reasonably fitted into two major groups, viz. those dealing with hydrogenation and those concerned with sweetening.

A. Hydrodesulfurization—A design for a reactor for combined desulfurization and reforming of naphthas over cobalt molybdena alumina is presented by C. H. O. Berg in Union Oil Co. of Calif.'s 2,893,945. K. E. Draeger and L. A. Nicolai (2,916,434 to Esso Res. & Eng. Co.) describe a flow design of a fluid bed unit for the treatment of both naphtha and coker distillate. See Fig. 2.

Hydrodesulfurization with cobalt-molybdena-alumina or molybdena-chromia catalysts is treated in the bulk of patents. Liquid phase contacting is discussed by R. Lester and H. T. Porter in one of three British Petroleum Co. patents (2,897,143) and also in Sun Oil Co.'s 2,897,141 (E. M. Honeycutt and F. R. Shuman). In 2,900,331 F. W. B. Porter and E. C. Housam (to British Petroleum Co.) desulfurize gas oil over cobalt molybdena alumina, containing 0.1-6 wt-% fluorine. L. B. Witten and Housam in 2,910,432 combat the loss of fluorine on regeneration by reversing the direction of flow during regeneration. Texaco patent 2,922,-759 (W. G. Schlinger) claims lower gum content of gasoline when following desulfurization by fractionation in the presence of hydrogen.

H. G. McGrath and J. A. Knaus (2,894,-903 to M. W. Kellogg Co.) relate sulfur content of the catalyst with severity of operation. C. Bednars, G. W. Stanford and J. L. Patton in M. W. Kellogg Co.'s 2,890,-165 desulfurize naphtha, which has been used to absorb hydrogen out of the gaseous effluent from the desulfurizer.

A method of reducing hydrogen consumption during hydrofining is proposed by E. H. Lewis and C. E. Thompson in 2,914,468 (to Esso Res. & Eng. Co.). Detailed specifications for the physical characteristics of a cobalt molybdena alumina are given in another Esso patent (2,924,568; J. A. Anderson, J. A. Dinwiddie and E. V. Hoffmann). C. H. Watkins (2,878,180 to Universal Oil Products Co.) discloses a cobalt molybdate catalyst comprising boron oxide and halogen. A catalyst containing molybdena on a porous carrier plus two metals of the iron group is claimed by R. A. Flinn and J. B. McKinley in Gulf Res. & Dev. Co.'s 2,-880,171.

F. C. Wood proposes partial deactivation of a cobalt-molybdena-alumina catalyst by gas oil contacting prior to contacting it with naphtha (2,891,906 to Union Oil Co. of Cal.).

A few patents deal with the use of platinum catalysts for desulfurization. M. D. Riordan and H. E. Vermillion (2,916,443 to Texaco) employ a spent platinum reforming catalyst for desulfurizing middle distillates. J. P. Thorn (2,816,196 to Esso Res. & Eng. Co.) desulfurizes with a spent reformer catalyst in the absence of external hydrogen. The catalyst is regenerated at 500-900 F with oxygen-containing gas. Union Oil Co. of Calif. patent 2,883,337 (F. L. Hartley and T. V. Inwood) describes a two-stage desulfurization patent with platinum catalyst being used in the first, cobalt-molybdena-alumina in the second stage.

Iron-nickel and chromia catalysts may be utilized in desulfurization. An olefinic hydrocarbon fraction is desulfurized with iron-chromia according to Hydrocarbon Research Corp.'s 2,891,003 (M. C. Chervenak, P. C. Keith and H. R. Pichler). A moving bed, three-stage process employing a nickel catalyst is disclosed in 2,921,022 (E. O. Sowerwine to M. H. Gwynn).

N. E. Peery (2,901,422 to Shell Dev. Co.) proposes adding finely divided metal, capable of reacting with H_2S, to the feed and passing it with hydrogen over a fixed bed of cobalt molybdena alumina. Metallic sodium on an inert support is used for the fluid bed desulfurization of petroleum distillates according to Eso's 2,902,441 (W. G. May, R. W. Wickler and H. J. Ogorzaly).

Combination processes involving hydrodesulfurization are claimed in another group of patents. F. W. B. Porter and R. P. Northcutt (2,892,774 to British Petroleum Co.) hydrofine gaseous and liquid hydrocarbons separately. H. F. Poll (2,908,626 to Union Oil Co. of Calif.) discloses a series of steps to treat a thermally cracked, high sulfur naphtha. W. L. Jacobs and W. G. Annable (2,897,142 to Pure Oil Co.) follow hydrodesulfurization by treatment with metallic copper or silver. Two Esso Res. & Eng. Co. patents (2,883,336; S. B. Sweetser and J. Weikart; and 2,901,417 D. E. Cook and E. J. Barasso) describe processes for the desulfurization of coker products.

B. *Sweetening*—Copper chloride treating and reactivation of the copper chloride catalyst are the subject of Sinclair Refining Co.'s 2,914,467 (C. F. Cross). An improved doctor sweetening process is claimed by F. W. Brooks, Jr. and H. R. Sharpless, Jr. in Socony-Mobil Oil Co.'s 2,879,227. L. F. King (2,906,706 to Esso Res. & Eng. Co.) removes sulfur compounds from naphthas by reaction with an ethylene polyamine, containing 0.1-10 wt-% NaDH. G. G. Lukk, G. H. Caesar and S. Ilnyky (2,908,637 to Esso Res. & Eng. Co.) convert mercaptans to disulfides in the presence of oxygen over a catalyst comprising activated carbon, alkali hydroxide and water. Sweetening with oxygen, alkali hydroxide and alkali phenolate and methods for regeneration of the treating solution are described in Shell Dev. Co.'s 2,893,951 (W. J. Pieters, and C. D. TenHare). In another Shell Dev. Co. patent (2,915,461) T. T. Davies and D. G. Roberts disclose a multistage sweetening process, employing an alkaline hypochlorite solution.

Sweetening processes can be improved by obtaining good contact through use of a methacrylate dispersing agent, according to R. G. Bowers in Sun Oil Co.'s 2,891,002. W. K. T. Gleim and P. Urban (2,882,224 to Universal Oil Products Co.) claim a process for sweetening with metal phthalocyamine in the presence of alkali and air. According to the same company's 2,921,020 and 2,921,021 Urban and Gleim employ a cobalt or vanadium phthalocyamine disulfonate catalyst.

REFINING. As in previous years a number of miscellaneous patents and subjects are combined in this group. Its size is meaningless, because of the variety of subjects treated. It should be noted, however, that there has been a substantial increase in the

number of patents dealing with metals removal and a decrease in those concerned with separation techniques.

A. *Metals Removal*—Six Esso Research and Engineering Co. patents treat metals removal. W. J. Mattox and C. N. Kimberlin (2,884,369) contact heavy gas oil with coke at 300-750 F. In 2,891,004 Mattox removes iron-nickel and vanadium compounds by reaction with boron compounds. N. P. Peet in 2,895,902 describes a deasphalting operation, in which metals are left in the asphaltic fraction. H. Ernst (2,911,-355) improves operation of a fluid coking unit by increasing the metal contaminant concentration of the bottoms gas oil fraction, used for scrubbing. C. N. Kimberlin and W. J. Mattox (2,902,430) propose a treatment with 70-90% sulfuric acid to form a metal-rich sludge. Solvent extraction with aqueous pyridine as a means of metal removal is claimed by L. K. Beach and J. E. Shewmaker in 2,922,760 (see Fig. 3).

According to J. W. Scott's 2,902,429 (to California Res. Corp.) metals can be removed by contact in the presence of hydrogen with cobalt molybdena on a low surface area carrier. A method of cleaving metalloporphyrin complexes with alkali or alkaline earth metals or with metal hydrides is proposed by J. G. Erdman and B. J. Lerner in Gulf Res. & Dev. Co.'s 2,902,442. Another Gulf patent (2,906,693; R. E. Donaldson) deals with solvent extraction. Metals are incorporated into a solid residue by treating oil with hydrogen at 2000-5000 psig in the absence of catalysts, according to Texaco patent 2,910,434 (H. V. Hess and J. Ryer). A Phillips Petroleum Co. patent (2,914,458; K. A. Harper) employs a clay and wash oil treatment to produce a low metals content oil.

B. *Nitrogen and Naphthenic Acid Removal*—Molecular sieves of 7-13 angstroms can be used to adsorb organic nitrogen compounds from hydrocarbons according to Union Oil Co. of California's 2,925,379; 2,925,380 and 2,925,381 (R. N. Fleck and C. G. Wight). J. L. Jozl (2,921,896 to Sun Oil Co.) removes basic non-hydrocarbon material from crudes by treatment with alkanol or ketone and an acid.

Naphthenic acids in lube oil stocks are preferentially hydrogenated over molybdena on alumina or silica-alumina, which has been pretreated with oxygen, according to L. W. Hoim (2,921,023 to Pure Oil Co.).

C. *Fuel Stability*—Odor, color and stability of petroleum distillates can be improved by treatment with at least 0.001% acetic anhydride, followed by sodium hydroxide as claimed in C. O. Hoover's 2,-889,195 (to National Aluminate Corp.). Hydrofining to eliminate gum formers without substantial reduction of olefins is described by M. C. Chervenak, P. C. Keith and H. R. Pichler in 2,891,006 (to Hydrocarbon Research Corp.). Another hydrotreating process is disclosed in Esso Res. & Eng. Co.'s 2,916,445 (E. W. Nommensen). C. H. Brooks (2,920,031 to Sun Oil Co.) uses the heat of regenerated cracking catalyst to vaporize unstabilized cracked gasoline and improve its stability.

D. *Separation Processes*—A considerable number of patents deal with the separation of xylene isomers and of ethylbenzene and styrene. A. M. Henke and A. E. Somers, for instance, in Gulf Res. & Dev Co.'s 2,-922,828, use active carbon to adsorb styrene and a magnesium silicate to adsorb ethylbenzene out of mixtures. F. R. Shuman (2,894,048 to Sun Oil Co.) hydrogenates a xylene mixture, obtained from a reformer, prior to fractional crystallization. J. M. Harrison and A. E. Somers (2,884,470 to Gulf Res. & Dev. Co.) separate para xylene from xylene mixtures by a super cooling procedure.

C. C. Wallin in Sun Oil Co.'s 2,892,001 discloses a process for purifying aromatics by a two stage adsorption. Separation of hexane isomers with perfluoro-trialkylamine as solvent is described in American Oil Co.'s 2,909,577 (W. H. Clingman, Jr.). R. S. Valentine (2,900,309 to California Research Corp.) is concerned with separating xylene diamines from aromatic nitriles. An extraction process for diolefins, using copper ammonium acetate is described by D. S. Alexander and W. A. Henry in 2,887,521 (to Polymer Corp.).

Molecular sieve applications are discussed in several patents. H. V. Hess and E. R. Christensen (2,886,508 and 2,886,509 to Texaco) remove straight chain hydrocarbons from mixtures. V. Haensel in U.O.P.'s 2,920,037 discloses a normal-iso paraffin separation with both, adsorption and desorption in liquid phase. A nearly isothermal adsorption desorption cycle is discussed in Esso's 2,901,519 (A. C. Patterson and H. Z. Martin). The same company's 2,920,038 (G. F. Feldbaver, Jr.; C. E. Jahnig and N. J. Weinstein) treats gasoline hydrocarbon separation with molecular sieves.

Improvements in urea adduct formation are discussed by A. Hoppe, H. Franz and K. Meliss in 2,917,447 (to Edeleanu G.m.-b.H.).

E. *Antiknock Agents* — Hydrogenated quinolines and indoles are claimed as antiknock agents in Socony-Mobil Oil Co.'s 2,-881,061 (J. A. Breman and C. C. Price). J. W. Bishop (2,881,062 to Tide Water Oil Co.) uses molybdenum naphthenate or tri (tertiary amylphenoxy) molybdenum dichloride to prevent knocking. W. M. Sweeney and R. Y. Heisler in Texaco's 2,-910,352 employ the reaction products of acetylenic alcohols and dicobalt-octacarbonyl as gasoline antiknock agents.

CRACKING AND COKING. Year in and year out, many cracking patents issue. Even though the number has decreased gradually over the years, it is still quite large, a surprising fact, if one considers the age and size of the art. No attempt will be made in the present review to digest this field in a representative manner, since it is intended to devote a separate review to it in the nearer future.

Unit design features are the basis of one group of patents, such as Esso's 2,881,129 (J. M. Andrews, H. G. Corniel, N. P. Pect and W. K. Roquemore), Pure Oil Co.'s 2,890,164 (B. B. Woertz), Lummus Co.'s 2,920,034 (A. H. Schutte) and Phillips Petroleum Co.'s 2,917,564 (L. W. Pollock).

New catalysts are described in another group. E. J. Janoski (2,887,449 and 2,887,-850 to Sun Oil Co.) thus incorporates ruthenium and manganese oxide into cracking catalyst, while R. M. Kennedy in the same company's 2,891,904 discloses a siliceous catalyst containing lithium hydroxide. W. A. Pardee (2,897,136 to Gulf Res. & Dev. Co.) vaporizes a metal chloride on cracking catalyst. I. Kirschenbaum, K. K. Kearby and H. J. Ogorzaly (2,884,371 to Esso Res. & Eng. Co.) employ a molybdena-containing catalyst for cracking shale oil.

Combination processes constitute the bulk of process patents involving catalytic cracking. Only a few are enumerated below. 2,918,423 (J. D. Fear and F. R. Shuman to Sun Oil Co.); 2,882,218 (J. W. Jewell) and 2,900,324 (J. L. Patton and G. F. Timson), both to M. W. Kellogg Co.; Shell Dev. Co.'s 2,895,899 (F. Kunreuther and W. K. Meebott) and 2,921,014 (J. A. Marshall); 2,917,450 (R. J. Hengstebeck to Standard Oil Co., Ind.); 2,900,326 (F. E. Gilmore to Phillips Petroleum Co.); 2,906,690 (J. W. Brown to Esso Res. & Eng. Co.).

Cracking of heavy stocks is a subject of interest. G. A. Mills, T. H. Milliken, Jr. and D. H. Stevenson (2,914,459 to Houdry Process Corp.) crack residuum with a granular, moving bed catalyst in the presence of at least 25% steam. T. S. Mertes (2,925,-376 to Sun Oil Co.) cracks a solvent extracted heavy fraction. Coking is discussed in many patents, such as: 2,917,451 (F. A. W. Leffer to Universal Oil Products Co.); 2,878,162 (E. R. Clouse and R. C. Woerner to Sinclair Refining Co.); a large number of Texaco (2,888,393; 2,890,998; 2,884,899; 2,895,896; 2,920,032) and Esso patents (2,-879,221; 2,880,160; 2,886,510; 2,893,946; 2,906,689; 2,899,376).

Hydrocracking has been in the news recently with several new processes being announced. F. G. Ciapetta (2,914,461 to Socony-Mobil Oil Co.) hydrocracks with a platinum catalyst containing alumina and aluminium halide. Gas oil hydrocracking over a molybdena containing catalyst is discussed by K. K. Kearby and I. Kirschenbaum (2,885,346 to Esso Res. & Eng. Co.). A chromia-containing catalyst is disclosed in Union Oil Co.'s of Cal. 2,885,349 (R. C. Hansford). L. Schmerling (2,905,628 to Universal Oil Products Co.) employs a tri halide and aluminum metal catalyst.

Cracking to produce olefins is important for the petrochemical industry. C. C. King (2,890,256 to M. W. Kellogg Co.) produces ethylene by steam cracking. V. Meckler and A. H. Schutte and K. J. Korp's (2,908,625 to The Lummus Co.) are concerned with the pretreatment of heavy hydrocarbon feeds prior to pyrolysis. An electric arc process for making acetylene is disclosed in 2,-878,177 (H. Kroepelin and H. Kopsch).

END

HERCULES CONE PACKED STUFFING BOXES

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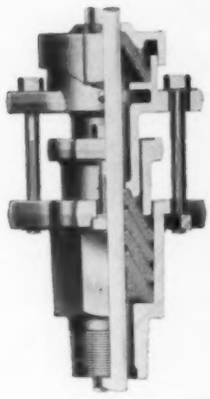
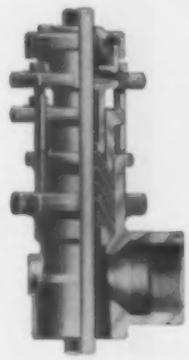


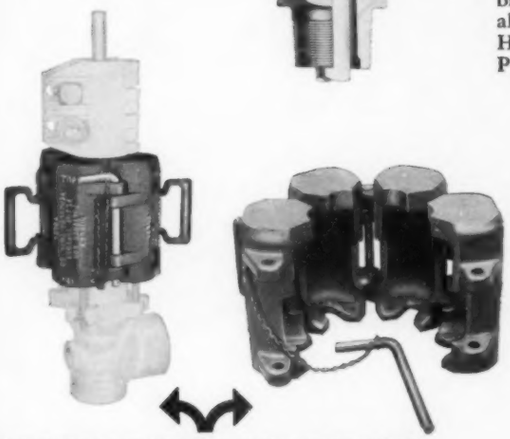
HERCULES REGULAR TYPE DUPLEX STUFFING BOX

More efficient operation with fine adjustment possible. Offers longer packing life due to ability of Packing and Glands to follow lateral movement of Polished Rod. Malleable iron construction prevents breakage if rods are accidentally dropped on Stuffing Box. Has male thread to screw into Pumping Tee.

HERCULES TEE TYPE DUPLEX STUFFING BOX

A combination Tee and Stuffing Box only 15" high. Eliminates one threaded connection between Stuffing Box and Tee. Full opening — allows rods to be run or pulled without removing Stuffing Box body. Has female thread to screw directly onto tubing.

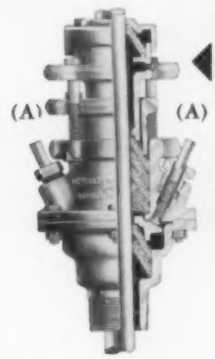




HERCULES POLISHED ROD CLAMP-OFF SUPPORT

Used with Hercules Regular and Tee Type Stuffing Boxes to *prevent accidents* or personal injuries while clamping off. Manufactured from high tensile aluminum alloy, will safely support 30,000 lbs. weight.

HERCULES TYPE DP (Double Packed)



Duplex Stuffing Box for use on high pressure or intermittently flowing wells. Allows Main (upper) Packing to be safely and easily replaced while well is under pressure. The two compression bolts (A) are turned clockwise until the lower Packing seals off. The Main Packing can then be removed and replaced.

HERCULES OIL RESERVOIR GLAND

All Hercules Stuffing Boxes may be equipped with *Oil Reservoir Upper Gland* on *problem* wells which pump off and burn packing. The polished rod runs through the Reservoir, and is cooled and lubricated by its fluid.

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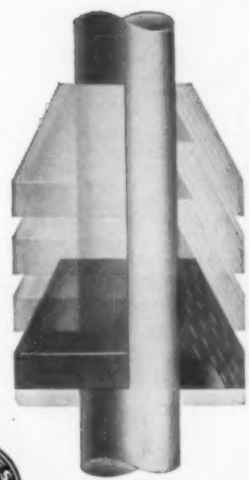

THERE'S A TYPE SPLIT CONE PACKING RING FOR EVERY REQUIREMENT:

Hercules Split Cone Packing Rings come in four grades: SOFT, HARD, SPECIAL LUBRICATED and HEAVY DUTY. SOFT Rings are always used with bronze liners or with steel polished rods in wells which are not always pumping fluid. HARD Rings are recommended for steel polished rods only, and where fluid is constantly being pumped. SPECIAL LUBRICATED Rings are recommended for problem wells which pump off persistently. When well is pumped dry, the rings lubricate the polished rod and prevent the packing from burning until fluid is again present. HEAVY DUTY Rings are recommended for problem wells. Properly adjusted, they give phenomenal life.

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Aerial view of Tranmere oil terminal. Twin jetty heads, each capable to taking a 65,000 dwt tanker, are in foreground; six 20,000 ton crude oil tanks on shore at right, and pumphouse and 15,000 ton bunker fuel oil tank at the left.

New Tranmere terminal

Giant marine facility on England's River Mersey can handle two 65,000 dwt tankers simultaneously, to supply crude oil to the Shell refinery at Stanlow

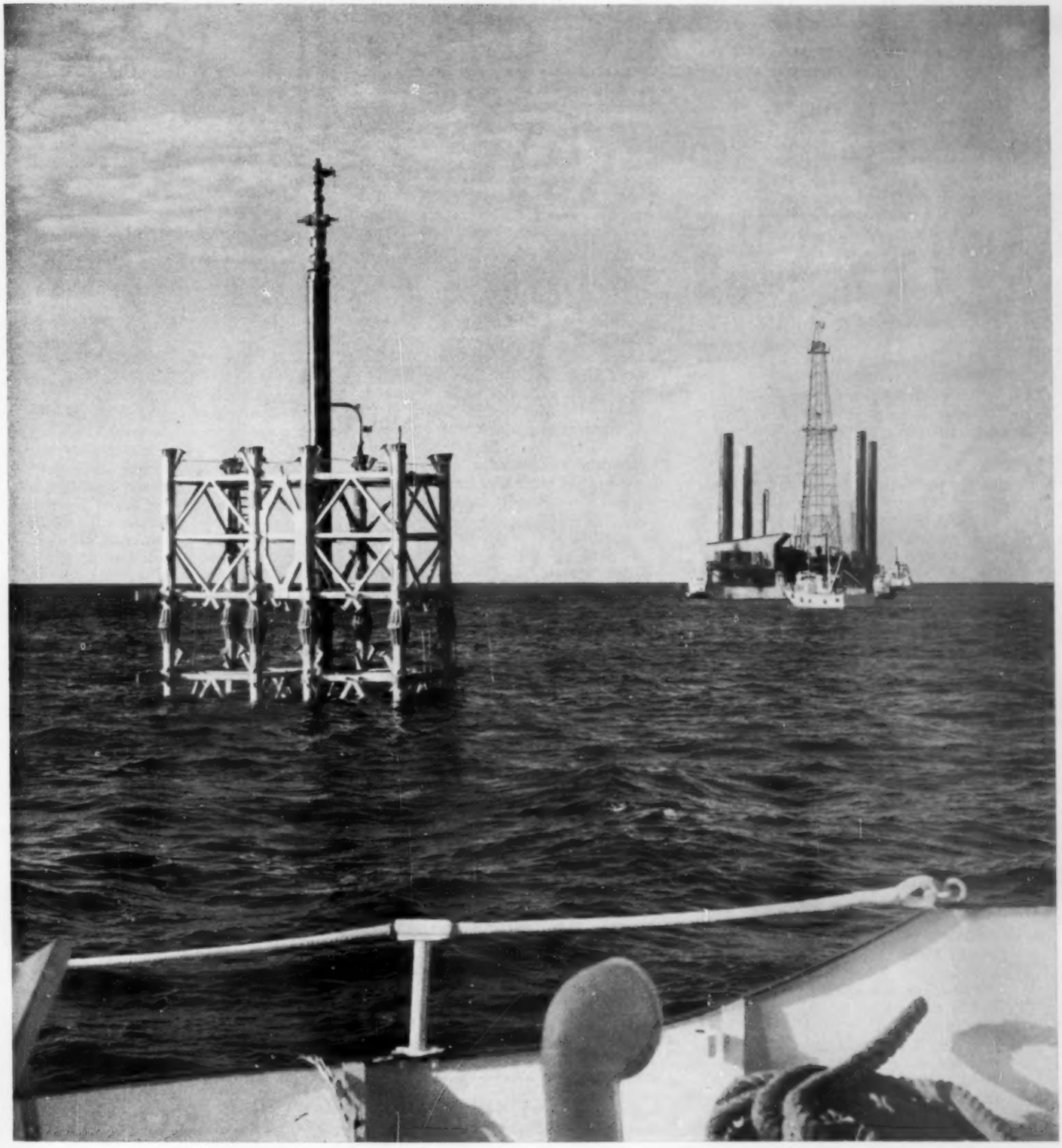
DEDICATED in mid-June, the new Tranmere tanker terminal for supplying crude oil to Shell's Stanlow, Cheshire, England, refinery, incorporates a number of novel features, particularly in its new type of mooring dolphins.

Designed by the Mersey Docks and Harbour Board and Shell Refining Co. Ltd., the facilities will be operated under their joint control. The project is on the Cheshire side of the River Mersey, nine miles from the Stanlow refinery, and adjacent to the shipyards of Cammel Laird where a $48 million reconstruction program will provide new drydock and tanker cleaning facilities.

The two large floating stages will each be capable of accommodating two fully-loaded tankers up to 65,000 dwt simultaneously, and even larger vessels on a restricted draft. In full operation, the installation with its adjoining new Shell tank farm will be capable of handling up to eight million tons of crude a year. The Queen Elizabeth II Dock at Eastham at the entrance to the Manchester Ship Canal can only take tankers up to about 30,000 tons. The Tranmere terminal will be connected to Shell's existing crude import facilities for Stanlow at Eastham by 24-in. pipeline.

Main contractors for the approach jetty and stages are Peter Lind & Co. Ltd., with Cleveland Bridge & Engineering Co. Ltd. for steelwork. The tubes for the staging anchorage system have been supplied by Mannesmann—Export GmbH, of Dusseldorf. For the tankage installation the main site civil contractor was A. Monk & Co. Ltd., other responsibilities being: pipeline principal contractor—Sir Alfred McAlpine & Son Ltd. (pipeline constructors—John Brown Ltd.); site oil pipework—George Wimpey & Co. Ltd.; and site firemain—Sulzer Bros. (London) Ltd.

Two flow boom systems supplied by Woodfield Rochester Ltd. were installed, each unit comprising six 12-in. booms desig-



ABU DHABI

A well head on the Persian Gulf. In the background, the barge "Adma Enterprise" which is currently drilling beneath the waters of the Gulf. The results are sufficiently encouraging to warrant the preparation of facilities for regular production. This stage should be reached by mid-1962.

BP

nated to accommodate 18,000 to 65,000-ton tankers. A 30,000-lb stores crane has been included in each unit. A central control cabin was mounted on the top platform level 44 ft from the top floor of each unit, which is mounted on the reinforced concrete cantilever jetty 35 ft above high water level to allow for the 30-ft tidal range.

The general technical requirements for which the project is designed are: tanker size, 65,000 tons; crude discharge rates—4,000 M^3/hr average and 7,000 M^3/hr maximum; fuel oil discharge rate—3,000 M^3/hr average; fuel oil loading rate (bunkers)—350 to 700 M^3/hr; crude storage capacity—115,000 M^3; fuel storage capacity—15,000 M^3; and crude transfer rate to Stanlow—1,300 M^3/hr, with possible increase to 2,500 M^3/hr.

Pumps capacities are: (a) 3 main crude (Mather & Platt)—650 M^3/hr at 1,200-ft head, 1,100 hp. (b) 1 crude transfer (Pulsometer)—500 M^3/hr at 50 psig, 100 hp. (c) 1 crude drainage (Joseph Evans)—50 M^3/hr at 50 psig, 10 hp. (d) 2 bunker pumps (Plenty & Son)—380/0/380 M^3/hr at 250 ft, 200 hp. These are constant pressure pumps with reversible flow for line clearing. Other requirements are two Cradley hot water boilers, each of 7,500,000 Btu/hr capacity.

Planning and development presented many unusual and complicated problems. Not the least was due to the big difference between low and high water levels which would have involved a vertical movement between a large tanker and the level of a normal fixed quay of as much as 60 ft, made up of a 30-ft tidal range plus a 30-ft pumping differential.

Originally the plan was for a single 2,000-ft long floating stage. This was redesigned to provide a discontinuous frontage of two floating stages, each 366 ft long by 62 ft wide, and the problem of placing the ships' head and stern mooring was solved by Shell Refining Co. engineers by developing an ingenious and entirely new floating mooring dolphin. Without this it would not be possible to reduce the stage length; further, it has resulted in a capital saving of over £1 million compared with one long continuous stage. Patent applications are pending for this new type of dolphin.

In the Tranmere dolphin the floating pontoons are of steel and have laminated nylon rollers which bear on the outside faces of the guide piles to prevent sticking. The pontoons are also free to rotate. Twelve such dolphins are installed, six per tanker, three each ahead and astern. Each dolphin is designed to withstand safely a horizontal pull of 150 tons applied at highest water. The 5 ft 5 in. diameter high tensile circular guide tubes up and down which the pontoon floats with the tide have been specially made by Mannesmann, of Duesseldorf. They have been grouted and concreted into 6-ft diameter vertical holes bored 30 ft deep into the sandstone rock of the river bed. Each steel dolphin pontoon has been made in four parts, and when bolted together and ballasted weighs 70 tons and has an outside diameter of 25 ft. The largest tube is 130 ft long and weighs over 100 tons.

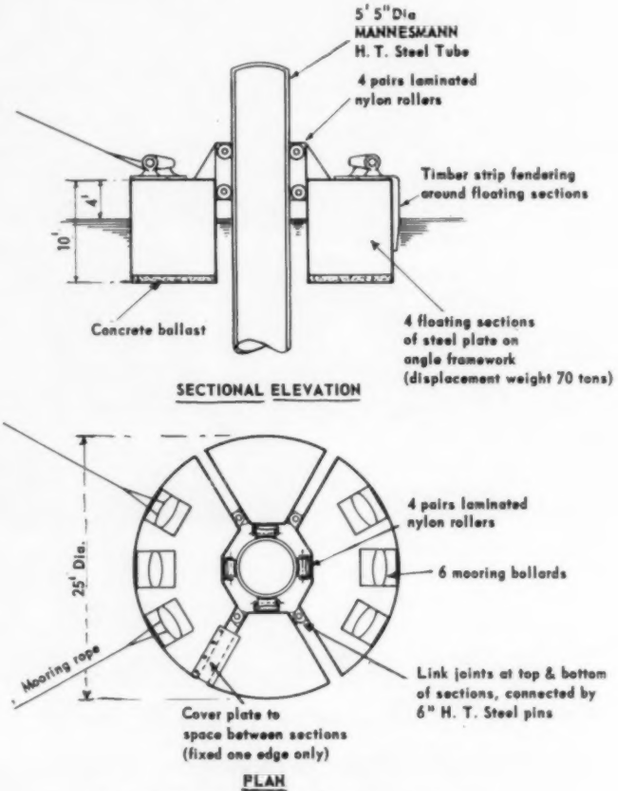
Another problem was bridging the 30-in. crude lines from an approach fixed in level on a floating stage, especially where tidal variation could cause a horizontal movement of the stage by as much as 16 ft. This was overcome by bringing the jetty head platform up to the rear of the floating stages and by arranging to cantilever them over so that the hose-handling gantries could be placed at fixed levels. This cantilevering forward is made from four 5-ft diameter prestressed concrete cylinders which pass through an opening in the center of the stage, the platform face being located 17 ft 6 in. back from the berthing face in its normal low water position to allow for the backward movement of the stage under wind load and berthing impact.

This arrangement has eliminated the complicated and expensive 150-ft span pipe bridges in the original design and all flexible pipe joints except those at the gantries, and the flow boom equipment will allow for a vertical ship movement of 70 ft.

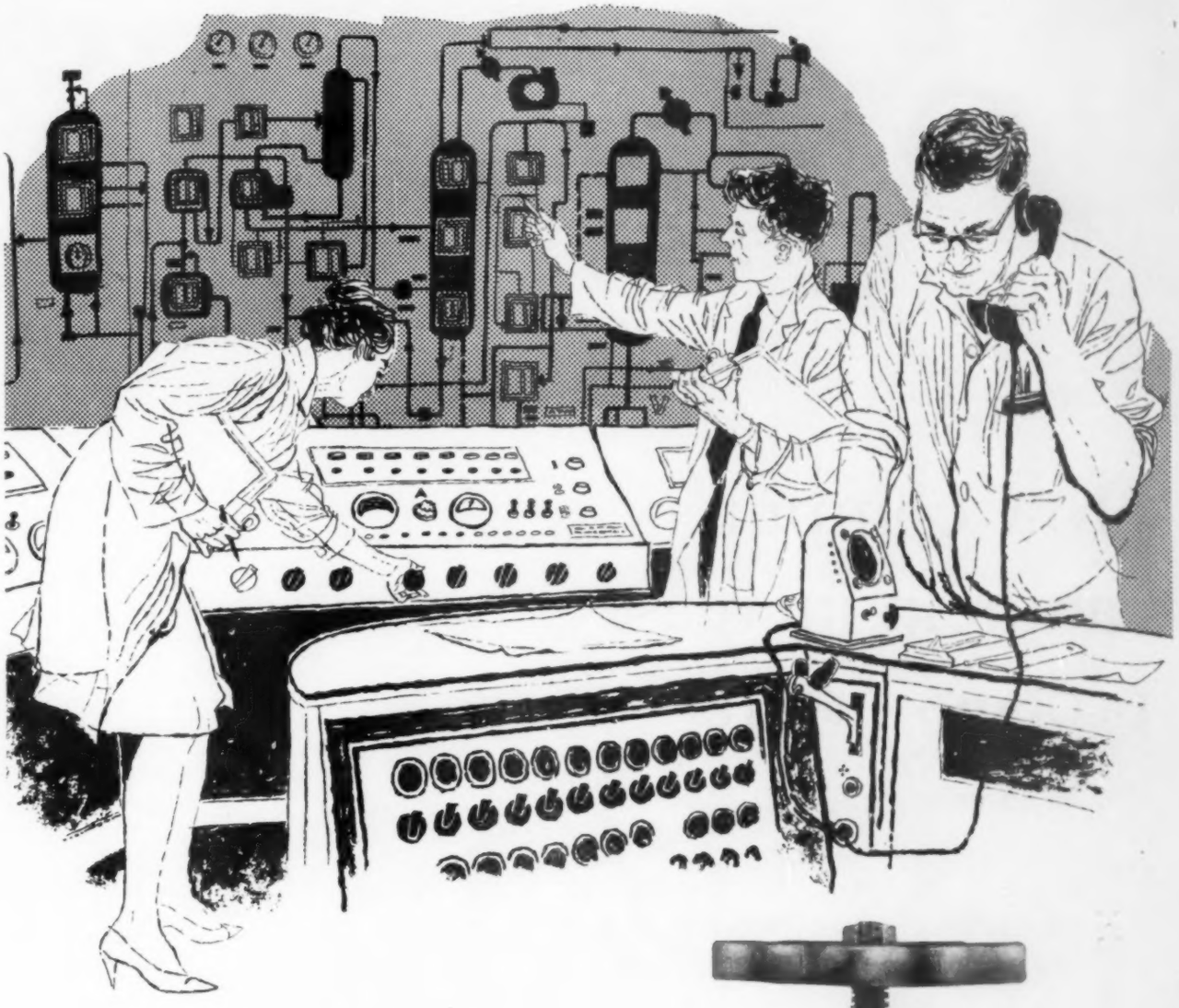
To be well on the safe side the jetty can, in fact, absorb 700 foot-tons of kinetic energy at either end of either stage. This would represent the full force of a total mass of some 80,000 tons berthing at a residual speed of about three-quarters of a foot per second. The jetty acts like a cushion both for its own protection and for that of the tankers. The entire stages are actually very large floating gravity fenders, each stage being held by four 150-ft long anchor booms to pairs of heavy Mannesmann tubes set in the river bed. During berthing, these anchor booms swing backwards and upwards against a 100-ton weight suspended from a link at the rear of each boom. The result is that the more the ship pushes, the greater the resistance encountered, until equilibrium is reached. The design of the whole stage anchorage system is such that it can withstand 375 tons of static horizontal force, such as could be caused by a gale blowing on the beam of a large tanker in ballast.

Development of the Tranmere project—believed to be the first of its kind in the world—has brought realization to those responsible that it can point the way to making greater improvements and economics for incorporation in future jetties.

As floating stages serve purely for berthing purposes, it may be possible to reduce their size considerably, and thus the costs. They would, in fact, become floating berthing booms and could be made either in reinforced concrete, steel or timber, and could lie to a row of piles or cylinders. It is thought that this system, used in conjunction with floating dolphins, is particularly suitable for tidal waters, extremely fast to build, and may be somewhat cheaper than construction. Certainly there would be a definite advantage to tankers from the cushioning effect of the floating booms. And with floating dolphins, there would be less need for mooring-line adjustment, combined with reduced tendency for lines to part when subjected to "snatch." END



Details of fabricated steel floating mooring pontoon.



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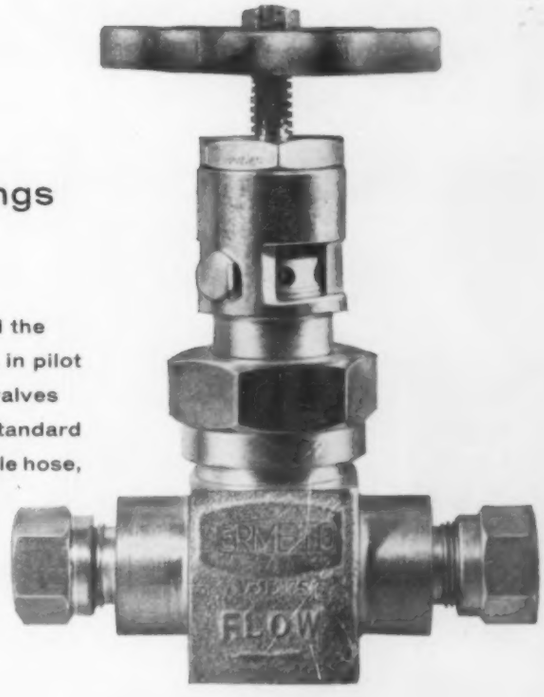

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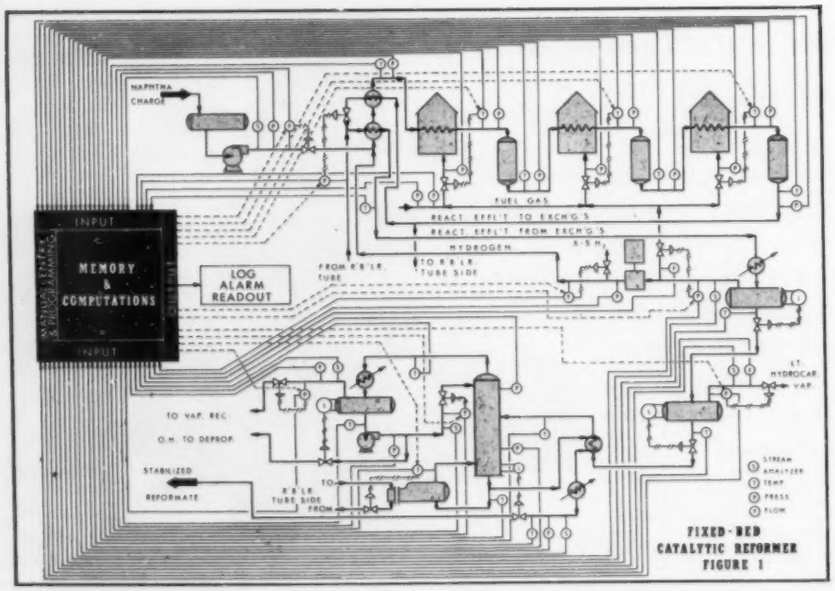
Meet the author

Reuben Silver is senior applications engineer for Information Systems Inc. (ISI), Los Angeles, Calif. He has been in process engineering and consultation for twelve years with additional business experience. Mr. Silver was associated with a major oil company and several large engineering and construction firms before joining ISI. He consulted on automotive anti-smog devices, catalytic sulfur removal from hydrocarbon streams, and special design problems. He holds a B.S. in chemical engineering from the University of Nebraska, and an M.S. in chemical engineering from the University of Southern California.

How computers can help increase process profits

by Reuben Silver

A down-to-earth discussion of the control of two important catalytic processes—cracking and reforming—and how much greater the profit dollars can be through the use of computer optimization



Flow diagram shows how computer control is adapted to a fixed-bed catalytic reforming unit.

TODAY'S AND TOMORROW'S difficulties facing the refinery manager in maintaining a good profit structure can be offset by process optimization using computer techniques.

Two specific examples of the extent of profit improvement possible, discussed in further detail later, are these:

- Gross annual profit can be raised some $77,000 on a typical catalytic cracking unit of some 21,000 b/sd nominal capacity for only a 2% increase in throughput.
- A further boost in annual profit of over $92,000 in the same processing unit can be attained for an increase of ½ octane number in the cat cracked gasoline.

This article will discuss the practical meaning of optimization and suggest fruitful areas of attack on the optimization problem in the refinery. Two processes, catalytic cracking and catalytic reforming, were selected for individual discussion because of their significant influence on profits.

Historically, refinery management has been progressive in adapting technological advances—in processes, in process equipment, and in instrumentation and control—to improve its profit-loss statements. Yet, today the American refiner is faced with necessity of taking still more profit from each barrel of crude oil. Process optimization remains the only route to increased profits for presently operating petroleum processes.

Profit increases will result from computer optimization of a process by reason of one or more of the following:

(1) More economical utilization of process products in the overall refinery picture.
(2) Smoother operation and fewer upsets.
(3) Increased throughputs, a closer approach to ultimate plant capacity.
(4) Improved product qualities.
(5) More economical plant operation.
(6) Higher plant service factors, less downtime.
(7) Elimination of operator errors.
(8) Longer catalyst life.
(9) Less maintenance, better scheduling of maintenance.

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The ultimate in optimization of a process consists generally of two parts: off-line optimization, and closed-loop optimizing control.

Off-line optimization results from a study of the process variables such as charge stock composition, temperatures, pressures, charge rates, etc., as they interact and as they affect product yields and qualities over the full range of variation of the variables. Such a study goes deeply into the chemical equilibria and kinetics, the process and control dynamics, and the overall process economics. The study also includes the process as an integral part of the entire refinery economic scheme. The installation of some special instrumentation is generally required for the study. This includes in-line stream analyzers to sense instantaneous changes in process stream compositions and fast chart-drive recorders to pin-point in time the changes in the process variables. A valuable adjunct to such a study is the installation of a logger or of a computer-logger to acquire accurate process knowledge in a usable form.

This study requires many man-months of effort on the part of specialists. Voluminous data is gathered which is difficult to correlate. It is likely that the information gathered during a two-hour actual test run on the process may need two man-months for complete data reduction. The use of computer techniques in the reduction and correlation of information goes far toward reducing the time required for the study. This is not new information to refiners since most of them already own computers or rent computer facilities.

Most refiners at this time are in the process-study phase of optimization, in the contemplation, planning or pursuit of one or more such studies. Many have already realized substantial profits before completion of the study by reason of knowledge gained at various stages. When complete these studies result in the knowledge of exactly how to operate the processes studied to obtain the maximum profit from each process, regardless of changes in charge composition or process variables, and from the entire refinery or petrochemical installation. The next step is the actual controlled operation of the processes for optimum profit according to the information resulting from the study: closed-loop optimizing control. Many refiners are considering this step; a few are taking it. Before describing closed-loop optimizing control, a discussion of the present status of conventional control systems is made.

Each item of conventional control equipment controls, on the basis of the set-point, one or at most two process variables at specific points in the process. This equipment does not have the capability of making a decision based on the interaction of process variables. This decision is made by the human operator, who adjust controller set-points accordingly. The process performance as regards profit depends largely on this decision.

Process performance is generally judged on the basis of yields and laboratory tests made on the products. Samples for these tests are taken periodically at various points in the process and from the product storage tanks. Consequently, the results of these tests show instantaneous process performance at various time intervals, and the average performance over a longer period of time. This average includes periods of operation producing above-specification and below-specification products and all periods of upset operation.

The procedure does not admit of continuous knowledge of the process performance. To alleviate this situation most refiners are considering or have already installed continuous stream analyzers. Many have profited through the resulting capability of closer process control. Some are attempting process control by cascading the stream analyzer with one or more conventional controllers. Though in many cases this is advantageous, only a refinement of conventional control is accomplished. The interactions of only a very limited number of process variables at specific points in the process can be recognized. The system is incapable of accounting for the interaction of the separate control loops.

Decisions must still be made by the human operator, and his subsequent set-point adjustments reflect his skill, experience and knowledge of the process. Since these factors inevitably vary among individuals, many techniques of operation exist among a given group of operators. All of these techniques may be more or less correct inasmuch as the process continues to operate at a profit. But for each given process unit, each charge composition, and each specific product quality and quantity requirement, for true optimum operation there exists only *one* technique of operation.

It is the purpose of the off-line optimization study to determine for each given set of conditions this one technique of operation which results in maximum profit. It is the purpose of closed-loop optimizing control to implement the process unit for accurate, automatic control in accordance with the applicable technique at any instant. This means operation of the process unit continuously at its optimum. In case there is an unpredictable change in any process variables, this also means bringing the process back to optimum operation *along the minimum path,* which the human operator can do only by luck. This is especially important now when imported and domestic crudes of varying compositions may be refined at a single location. It is suggested that the control computer, accurately programmed for closed-loop optimizing control, is the answer. The accuracy and reliability of present-day process control computers have been developed to the requisite level.

As presently planned, the process control computer and logger, and the existing conventional instrumentation in the plant, form the control system in a computer controlled plant. In many cases the conventional alarm system will not be replaced. The computer replaces the human operator in the decision function and in conventional-controller set-point adjustment. The computer has direct access to all significant process data by being connected through transducers to the conventional sensing instrumentation.

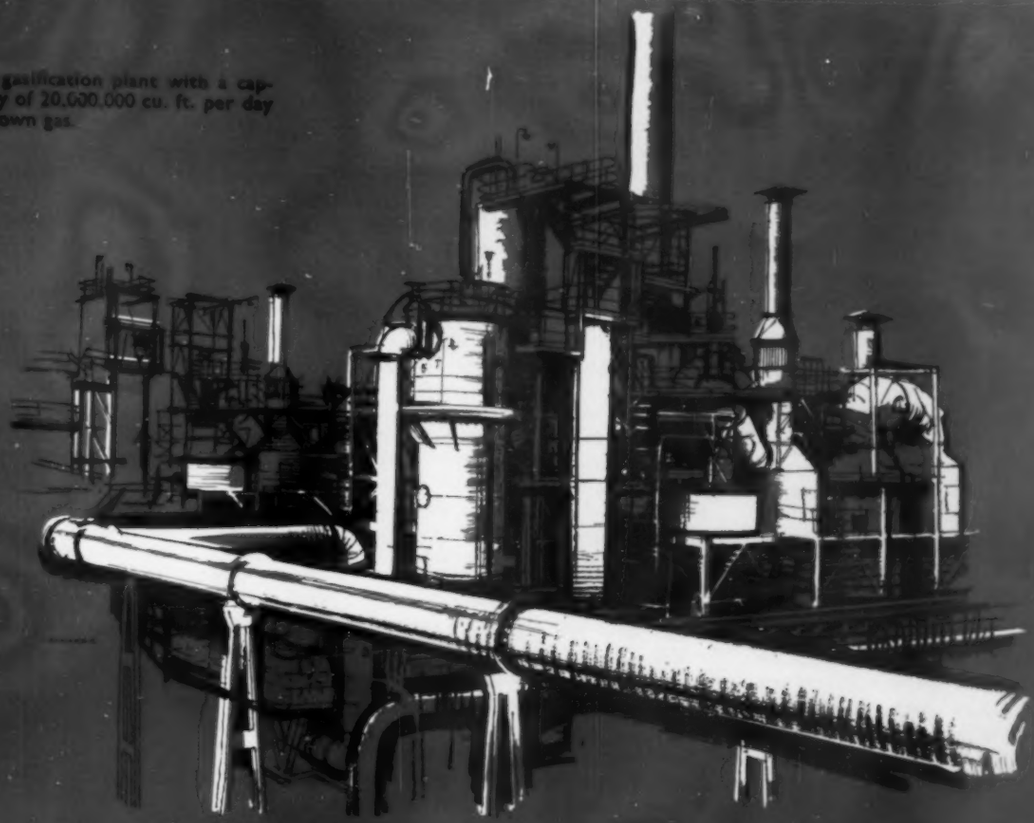
On the basis of its program, the computer correlates the data, selects the applicable technique of operation for maximum profit and automatically adjusts the set-points of the significant conventional controllers accordingly. The control system has the feature that should the computer be taken off-line for any reason, the conventional controllers continue to operate the process at the most recent set-points. The computer is also programmed to handle certain emergencies and to initiate plant shut-downs under some conditions. But the computer does not obviate the human operator who can at any time overpower the computer or change the program on the basis of new information. The human operator is, in addition, present to handle major emergencies for which the computer has not been programmed, such as fire.

Let us now examine the two processes most important economically to the manufacture of saleable products—catalytic cracking and catalytic reforming.

Catalytic Cracking. It is generally recognized today that the catalytic cracking processes—for years among the largest money-makers in the industry—cannot now produce the desired octanes. At the same time, catalytic cracking remains the most economical use for gas oil. Refinery management must increase the cat cracker charge to utilize more gas oil, and must increase process selectivity to improve the octane number of the cat cracked gasoline.

Though catalytic cracking is one of the oldest large scale catalytic refinery processes, it is generally less understood than more recent processes due to its complexity. Almost all of the process variables are interdependent; almost all of the control loops interact. Partly for these reasons catalytic crackers tend to have individual personalities. Due to the presence of a moving—or fluidized—solid catalyst bed, both the charge rate and catalyst circulation rate can be controlled. Consequently, the catalytic cracker is normally not as sensitive as the reformer in the inverse relaship between charge rate and product octanes.

Though the off-line optimization study of the catalytic cracker is doubtless among the most complex which will be performed for the refinery, few larger potential profit increases exist in the refinery by reason of optimization. The catalytic cracker operator has probably less control over the charge stock quality than over any other process variable, and this variable is doubtless one of the most important. On account of these facts, many refiners have been mak-



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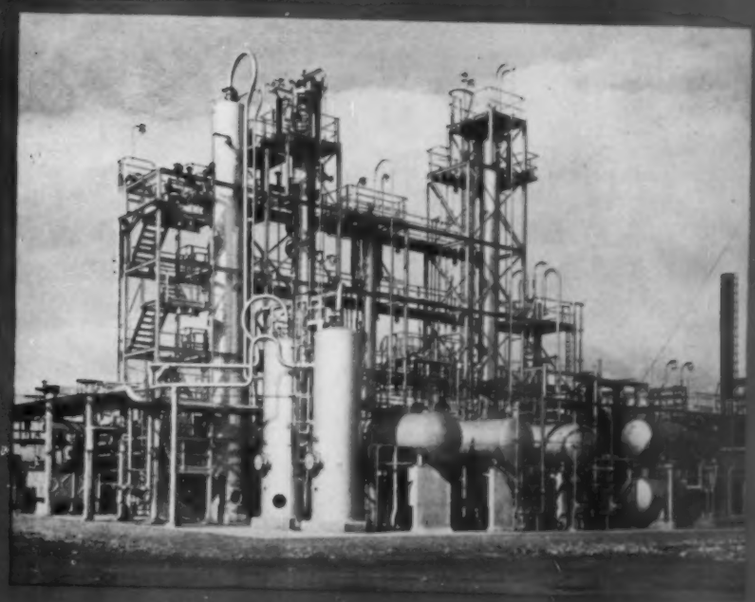

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ing extensive investigations into the effects of various charge stocks on product yields and qualities. It has been known for some time, for example, that the presence of 1% of 40 octane straight run gasoline in the charge normally reduces the product octane by one number, assuming a 40% yield of 80 octane gasoline if pure gas oil is cracked. It is also well known that it is generally more economical to crack gas oils from the coker or other thermal operations rather than to recycle the cat-cracked gas oils.

Simultaneously with the study of the effects of charge stocks, the off-line optimization study of the other process variables can be made. The Box-Wilson method of steepest ascents[2] or a similar technique is recommended for the practical experimental study. The techniques of chemical engineering thermodynamics and kinetics are used for the theoretical study. The process dynamics are investigated through servomechanisms theory[3]; the results of this are checked and corrected by means of actual dynamics information on the process gained from the computer-logger and fast-drive strip charts. This last study results in the knowledge of how to optimize the process along the minimum path as discussed earlier. Basic profit equations and some simple calculations are in the next section.

Catalytic Reforming converts low octane straight run naphtha into aviation grade gasoline or high octane motor fuel components, principally by aromatization of the paraffins and naphthenes in the charge stock. The process also produces aromatic compounds in the petrochemical field.

Reforming is a high temperature, high pressure process carried out in a hydrogen atmosphere. Consequently special materials of construction and specialized compression equipment are required. The catalyst is expensive, representing a large initial investment and necessitating precautions to prolong catalyst life and to prevent poisoning. All of these factors have profound effects on the economics of the process. The catalytic reformer must also especially be considered in its relation to the overall refinery economic picture, as demonstrated in the following paragraphs.

The majority of catalytic reformers are fixed-bed processes. Considering such a reformer, partly by reason of fixed-bed catalyst and partly due to other process constraints, maximum charge throughput and maximum octane number of the reformate are mutually exclusive. It is obvious then that maximum octane-barrels production occurs neither at maximum throughput nor at maximum octane, but somewhere between. But this is still not the answer to reformer optimization.

Most of the high-octane motor fuel sold today contains reformate. The highly aromatic reformate has a greater sensitivity and a lower lead susceptibility than paraffin hydro-carbons. Partly for this reason, but generally for reasons affecting the overall economy of the refinery, the finished gasoline in addition to reformate may also contain cat-cracked or polymerized gasoline, alkylate, isopentane, butanes and TEL. The ultimate objective is optimization of the economics of the entire refinery. Since this can be achieved by minimizing the gross cost of the salable refinery products, assuming selling prices are largely influenced by the competition, a step in this direction is recommended as the first phase of reformer optimization. Many refiners are already pursuing this step.

For a proposed gasoline blend, the information available immediately is the required characteristics of the blend, its desired quantity, and the quantity of bulk blending stock which is to be blended. The difference in characteristics between the bulk blending stock and the required finished blend must be made up with the various blend stocks and additives at hand.

Most refiners already know quite closely most of the various blend compositions within their capabilities which fit any blend specification they are likely to require. The refiner must then select that blend which is within his capabilities at the time and which has the minimum gross cost, including the actual cost of blending.

It is not unusual to compare fifty possible blend compositions (in a few cases over one hundred), all of which have the desired characteristics, to determine the optimum blend. Several man-weeks of time may be consumed by an expert unless computer techniques are used. The basic gross cost equation of the blend is given later.

Once the blend composition has been fixed, the reformate requirement both in quantity and quality is known. It remains then to operate the reformer to produce the requisite quantity and quality of product. The results of the off-line optimization study show how to do this in the most economical way; closed-loop optimizing control actually does it. Only by rare chance will reformate production for optimum blend composition coincide with that for maximum octane-barrels. Some refiners have already realized large profit increases by optimizing blend composition with attendant changes in reformer operation. This is usually the result also of increased catalyst life, higher plant service factor and less maintenance, due to less severe operation.

At this point it is apparent that blend composition optimization cannot be done once for all time. Rising general costs, changing product requirements, transient process of economic conditions within the individual refinery or its sales territory, and the updating of blend-component gross costs due to new knowledge or process changes, each forces a reevaluation of the optimum blend composition. It is obvious then that as knowledge of each process contributing to the blend increases during an optimization study, the optimum blend composition must be updated. The situation is dynamic, requiring tight control at all times. The catalytic reformer process, its economics and its automation, have already been discussed in some detail elsewhere.[1]

Process Economics. For any catalytic process, the net profit equation is:

$$Z = \Sigma A_i V_i - \Sigma B_j V_j - \Sigma U_k V_k - C - M - L - O - F$$

where

- Z = annual net profit
- A_i = annual production of the ith product
- B_j = annual consumption of the jth charge stock
- U_k = annual consumption of the kth utility
- V = unit value or cost of a product, charge stock or utility, including royalties where applicable
- C = annual catalyst cost and chemical cost
- M = annual maintenance cost
- L = annual direct labor cost
- O = annual overhead or burden
- F = annual fixed costs (amortization, taxes, insurance, etc.)

It is plain that net profit is optimized by maximizing $\Sigma A_i V_i$ and by minimizing the remaining terms on the right hand side of the equation. Setting net profit equal to zero, the gross cost of the products is calculated:

$$\Sigma A_i V_i = \Sigma B_j V_j + \Sigma U_k V_k + C + M + L + O + F$$

Letting each product bear that portion P of the processing cost that it represents of the total products such that $P = A_1/\Sigma A_i$, the annual gross cost of product A_1 is:

$$A_1 V_1 = P\,[\Sigma B_j V_j + \Sigma U_k V_k + C + M + L + O + F]$$

(though admittedly in many cases this will not be in accord with the refinery accounting system). From this the unit gross cost of product A_1 is:

$$V_1 = P/A_1\,[\Sigma B_j V_j + \Sigma U_k V_k + C + M + L + O + F]$$

Blend optimization consists of minimizing the gross cost equation of the blend:

$$D = \Sigma S_i\,[Q_i + V_i] + \Sigma T_e\,[Q_e + V_e] + W$$

where

- D = the gross cost of a unit of the blend
- S_i = that portion of a unit of the ith blend stock in a unit of blend
- T_e = that portion of a unit of the eth additive in a unit of blend
- Q = the cost of storing and handling a unit of stock or additive up to the blender; this item includes utilities, maintenance, labor, overhead and fixed costs
- V_i = the value or gross cost of a unit of the ith blend stock
- V_e = the cost of a unit of the eth additive
- W = cost per unit of blend for the blending system itself, including handling and storage of the blend

The reader is referred elsewhere[1] for economic calculations on the catalytic reformer, but some simple calculations below on a typical catalytic cracker of 21,000 b/sd

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nominal gas oil throughput capacity serve to demonstrate the large economic potentials of this process.

For a 2% increase in throughput, assuming 60% conversion, the additional daily charge stock cost @ 8¢/gal ($3.36/bbl) is

$$21{,}000 \times .02 \times .6 \times \$3.36 = \$846.72/\text{day}$$

This assumes utilization value of cracked gas oil equal to virgin gas oil.

Neglecting the dry gas and assuming 44 vol-% yield of debutanized gasoline @ $4.62/bbl and 22 vol-% of C_3's and C_4's @ $2.31/bbl, the additional daily products value is

$(21{,}000 \times .02)\ [(.44 \times \$4.62) + (.22 \times \$2.31)] = \$1{,}067.22$/day

$\$1{,}067.22 - \$846.72 = \$220.50$ additional daily gross profit

350 days/yr $\times$ $220.50 = $77,175.00 additional annual gross profit

For an increase of ½ octane number in the cat-cracked gasoline, assuming the same yields and values as before, the increase in octane-barrels produced daily is: $21{,}000 \times .44 \times ½ = 4620$/day.

At a value of $0.057 per octane-barrel, the increase in daily profit is:

$4620 \times \$0.057 = \$263.34$/day

350 days/yr $\times$ $263.34 = $92,169.00 additional annual profit

The Future of Refinery Optimization. The installation of continuous, in-line stream analyzers is the first order of business in process optimization. Most refiners are now at least aware of the value of such equipment as gravity analyzers, moisture analyzers, chromatographs, dielectric-constant analyzers, etc., in gaining process knowledge for closer control. Still lacking at this time but under intensive investigation is the in-line octane analyzer which will be generally accepted by the industry. Simultaneously, the number of off-line optimization studies will increase. Aided by computer techniques, many refiners will find it advantageous to pursue such studies both on a particular process, such as catalytic cracking, and on the refinery blending system. The same computer can be used for both.

A major portion of refinery product sales result from blending operations. Keeping in mind such truisms as "giving away octanes is giving away dollars" and "time is money," many refiners will culminate a blender optimization study with the installation of a computer-automated in-line blending system. Such systems are able to maintain blend compositions very close to that desired and to blend directly to tank cars or trucks, thus releasing mixing tanks to other services and decreasing the required blend storage capacity with its attendant storage losses.

On the point of closed-loop process optimizing control, the petroleum industry is now generally somewhat behind the chemical and the utilities companies. But on the basis of history, closed-loop computer control would seem to be an inevitable evolutionary development throughout the process industries. Electronic rather than pneumatic instrumentation will save money on new process units when computers are installed.

Labor organizations have already indicated alarm at the possibility of human operators being replaced by control computers. By now most have been assured that no general lay-offs will be occasioned by reason of control computer installations. It is believed that the rate of computer development and installations will be such that companies can abide by this agreement by curtailing new employment, and allowing the normal employee attrition by turnover and retirement to be offset by gradual automation. The skilled operator will be definitely needed for some time to come, but this operator must acquire new knowledge and new skills in keeping with the age of automation. It would seem to be the responsibility of refinery management to see that he is afforded the opportunity to do this.

Engineering contractors are today largely using computers in plant design. The closeness of design made possible will result in lower design safety factors with fewer equipment capacity bottlenecks and lower costs to the customer. Innovations in design philosophies, such as decreased surge capacities and increased process unit and refinery integration, will be made possible.

Digital computers for process optimization today can be said to be in their second generation. The first generation utilized vacuum tubes and wired circuitry with perhaps a two-thousand-word memory capability. The second generation features solid-state, printed, modularized circuitry with tremendously improved reliabilities, and memory capacities of 4,000 to 8,000 words. Such computers in optimizing control are intended to utilize the existing analog cascade controllers for the actual process control and to supervise the control system by adjusting the set points for optimization.

Now, barely at the beginning of industrial closed-loop optimization, the third generation of computers is being considered. Computer systems engineers are already realizing that the computer capabilities which will in the future be required by industry for the scanning, monitoring and alarming of process variables and the controlled optimization of an industrial process have been grossly underestimated. They are thinking seriously of future memory capacities 10 to 100 times the present 4,000 to 8,000 words. With such computers, two new things may become possible. The first is direct control rather than the present supervisory control; that is, the replacement of the functions of the conventional control instrumentation by the computer, which will then take information directly from the process sensors and adjust control valves directly. In addition, the computer will take over all scanning, monitoring and alarming functions and a good deal of the process accounting.

The second possible innovation is something which has been called *dynamic programming.* Though such an application for a process has not yet been published, it is not actually new in concept.[4] In this mode of operation the computer need be programmed only basically and approximately. It learns how to optimize the process from planned and statistical process changes and upsets, eliminating the necessity for a prolonged process optimization study. The computer updates its own program and controls the process accordingly for maximum profit. If desired, the computer could search out weak points in the process or plant design and actually *teach* the refiner how to improve his next plant installation.

Further in the future, the goal would seem to be a generation of computers approximating the living brain in compactness—though not in capacity. The human brain, in a space little over one-tenth cubic foot, comprises an estimated thirty billion highly efficient, self-programming, multipurpose, input, memory decision and primary control circuit modules and the associated wiring; and the whole operates on very few watts. Could even the rapid memory-search mechanism utilized by the living brain be understood and duplicated, it would be a tremendous break-through in computer technology.

Also, further in the future, of course, lies the completely automated totally unmanned refinery, pipeline facility, petrochemical plant, power plant, mining operation, steel mill or industrial installation. Thus far, only intelligent guesses have been published as to the computer capability required for this. When the time arrives, several of these industries may well have changed so much as to be unrecognizable and speculation may, therefore, be pointless. Yet by extrapolating history, and with our present exponential rate of technological growth greater developments than these seem possible, and even inevitable. A start in this direction is shown in the accompanying flow diagram of a typical fixed-bed catalytic reformer with a computer in supervisory optimizing control.

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[2] R. W. Schrage (Esso, Linden, New Jersey), "Optimizing A Catalytic Cracking Operation by the Method of Steepest Ascents," presented as a paper at the Pittsburgh meeting of AIChE, September 9-12, 1956, and at the San Francisco meeting of Operations Research Society of America, November 15-16, 1956.

[3] R. E. Hall (Esso, Linden, New Jersey) and G. K. Tucker (Minneapolis-Honeywell, Minneapolis, Minn.), "Application of Systems Engineering to a Process Control Problem in Fluid Catalytic Cracking," presented as a paper at the New York meeting of API, Division of Refining, May 27, 1959.

[4] Book: Dr. Richard Bellman (Rand Corporation, Los Angeles, California), "Dynamic Programming." Princeton University Press, 1957. This publisher will shortly offer another book by Bellman, "Computational Aspects of Dynamic Programming."

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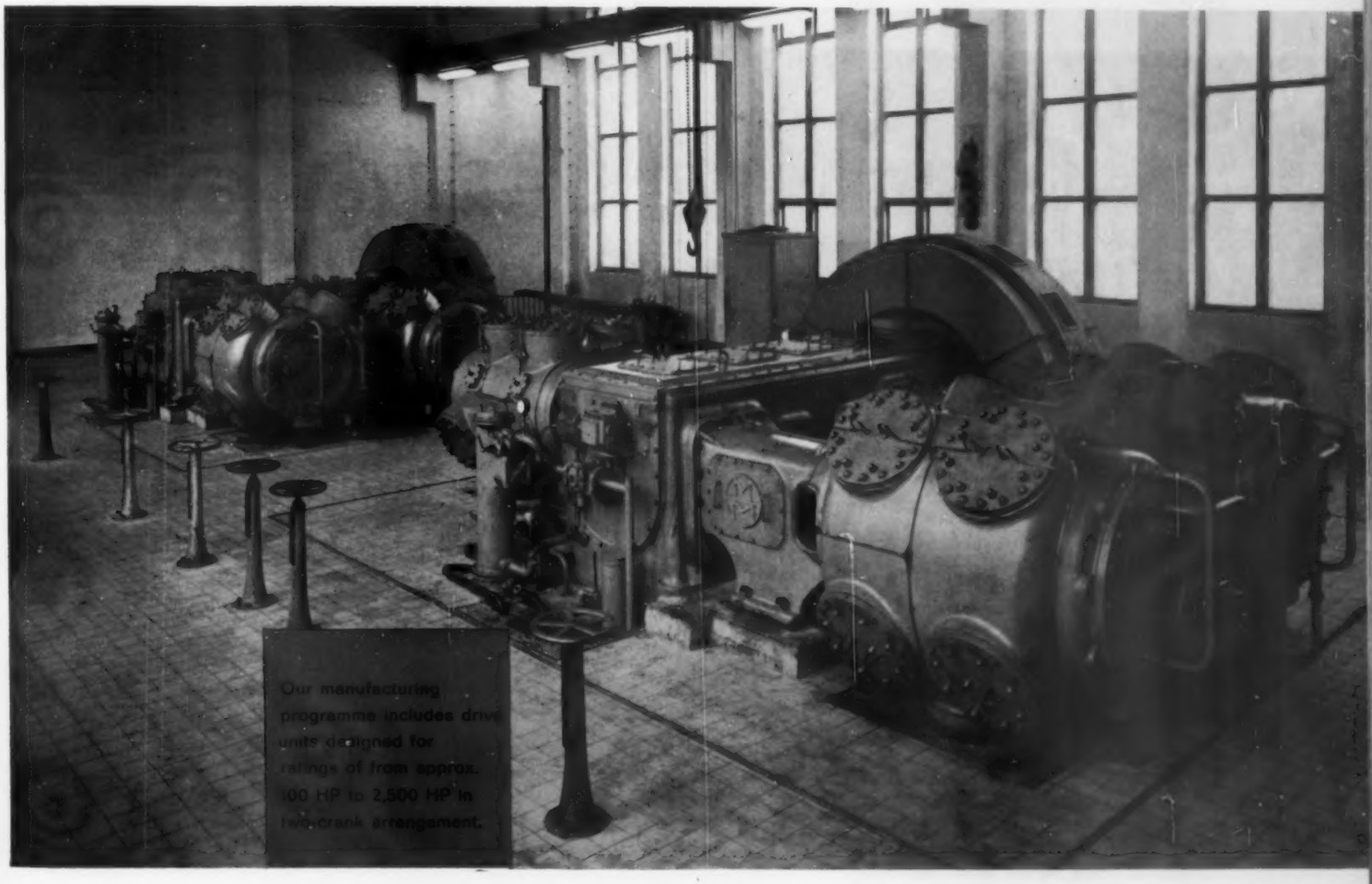
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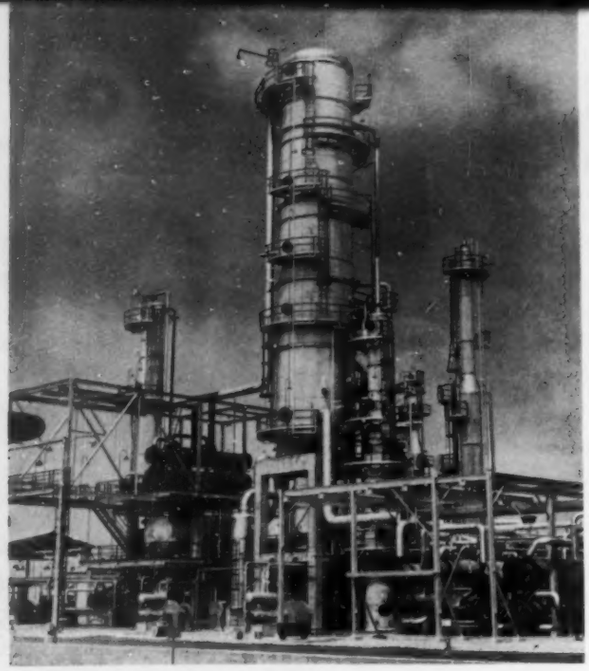
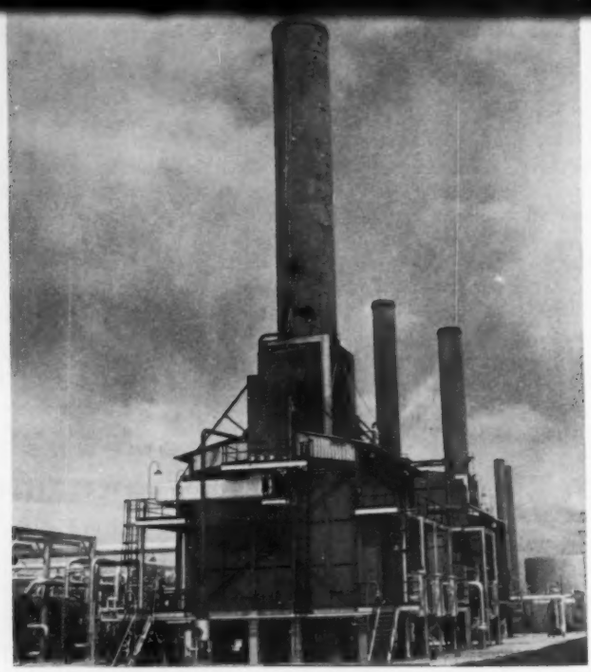


El Palito crude distillation unit. Depropanizer tower is at left and straightrun stabilizer is at right.



Crude unit furnace in foreground, with reformer furnace immediately behind it. Stacks in far background are for steam boilers.

El Palito—Mobil Oil's first refinery in Venezuela

THE NEW $28 million, 50,000 b/d refinery at El Palito of Mobil Oil de Venezuela, at the terminal of a 210-mile crude line from Barinas, is the company's first refinery in that country. El Palito is near the Caribbean port town of Puerto Cabello, about 100 miles west of Caracas.

Products from El Palito will include gasoline, kerosine, diesel fuels, residual fuels, and jet fuels. Aside from the crude distillation unit and products treating facilities, the only downstream process unit is a 6,500 b/d catalytic reformer.

The crude still was designed to process 28.4° API oil from Barinas at a maximum charge rate of 55,600 b/sd. There are three main towers in the gas recovery system: straight-run gasoline stabilizer, depropanizer, and a gasoline splitter. An important engineering economy designed into the system provides heat for reboiling the stabilizer and splitter streams by circulating the intermediate reflux stream from the crude still.

The catalytic reformer takes 6,500 b/d of naphtha feed and produces stabilized reformate and fuel gas. It is designed to operate over a wide range of severities depending upon the product characteristics desired. Special provisions include low-pressure flash separation of the reactor product.

Product treating—for kerosine, light straightrun gasoline, and butane—consists of caustic and water wash. After water wash, the gasoline and butane streams pass separately through coalescers for water removal. The kerosine is passed through a salt tower for the same purpose.

The gasoline blending system is designed to blend three grades of gasoline in blocked operation. However, each grade will consist basically of light straightrun gasoline, catalytic reformate, unreformed naphtha, and butane. Each component flows from process through intermediate storage to an automatic continuous blender. All flows are accurately and automatically controlled by a preset ratio flow controller located on the blender panel.

Blended product streams flow through the automatic tetraethyl lead blending plant which has a design capacity for 15,000 b/sd of finished gasoline, with the blending rate for TEL ranging from 0.5 to 3.0 cc/gal. A weigh tank at the plant has a 15,000-gal capacity, and the storage platform can handle 300 50-gal drums of additive.

A remote monitoring system provides for level indication of the refinery storage tanks. The main control panel is located in the control house in the process area. Unusual instrumentation from this central panel includes a complete viscosity-control on fuel oil production to insure uniformity and to conserve storage tankage by reducing batch blending needs. Product storage capacity at the refinery is nearly 1.5 million bbl.

Export products are being shipped from docks extending a half mile into the deep waters of the Caribbean and capable of loading two supertankers at the same time.

Prime contractor for the project was M. W. Kellogg Co. Equipment and supplies were obtained in Venezuela, the United States, United Kingdom, and France. Except for some of the heavier pieces of equipment, everything shipped to El Palito was packaged and crated especially for protection during shipment and against the hot climate. The four diesel-electric generators for the power plant, weighing about 100 tons each, were transported to the refinery site by an LST-type vessel which landed its cargo right on the beach, because there was no crane available of sufficient strength to off-load such equipment from an ordinary freighter.

One early and intriguing problem involved with site preparation was to move the Pan-American Highway. This two-lane roadway originally ran directly through the middle of the proposed construction area. It was moved inland, off the refinery property, a maximum of some 1,000 yards from its original position.

The total investment of some $28 million includes the refinery proper, a separate 750 b/d lubricating oil blending plant, marketing facilities, a diesel-electric power generating plant, an administration building, and a special fresh-water collection system.

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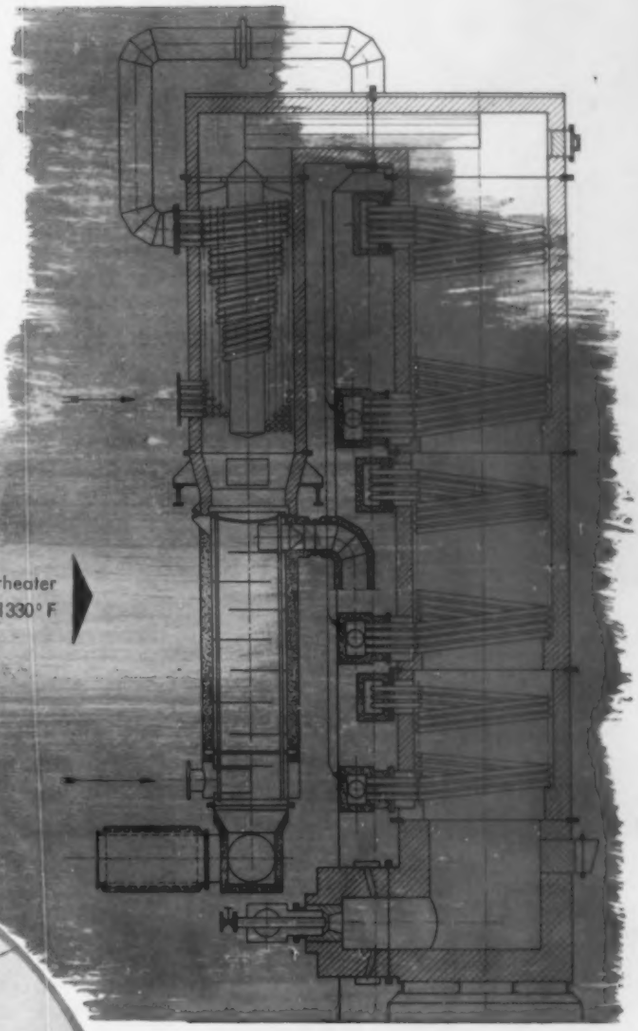

Schematic drawing of a recently completed Steam Superheater for 11 tons/hr. Preheats from 680° F to 1330° F

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Panoramic view of Esso Nederland's new 100,000 b/d refinery at Rotterdam. Left to right, light ends and feed splitter, crude distillation unit, Powerforming, and Hydrofining units.

Rotterdam refinery dedicated

BUILT WITH AN EYE to the growing future oil market, the new $56 million, 100,000 b/d refinery of Esso Nederland N. V. at Rotterdam was officially dedicated May 12 in a formal ceremony by H.R.H. Prince Bernhard of Netherlands.

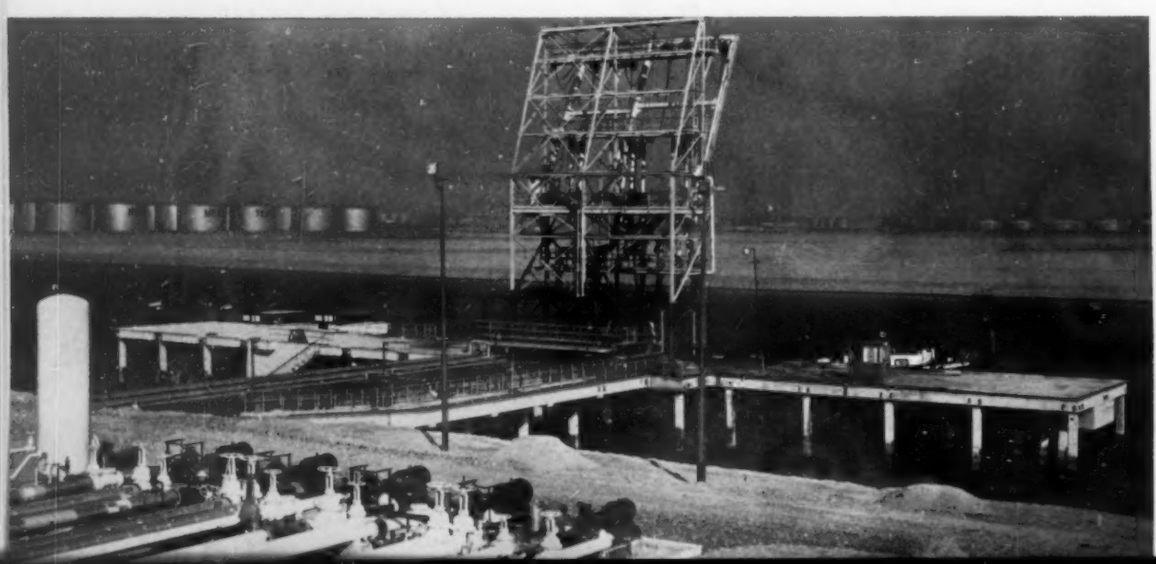
In an address prior to the actual opening by the Prince, Mr. P. T. Lamont, vice president and director of Standard Oil Co. (New Jersey), pointed out that the Rotterdam refinery, the culmination of planning begun four years ago, has expansion built into it.

"Thus we will be able to meet increased demands for oil in Holland and in adjoining areas for a period of time without having to add to its capacity," he said.

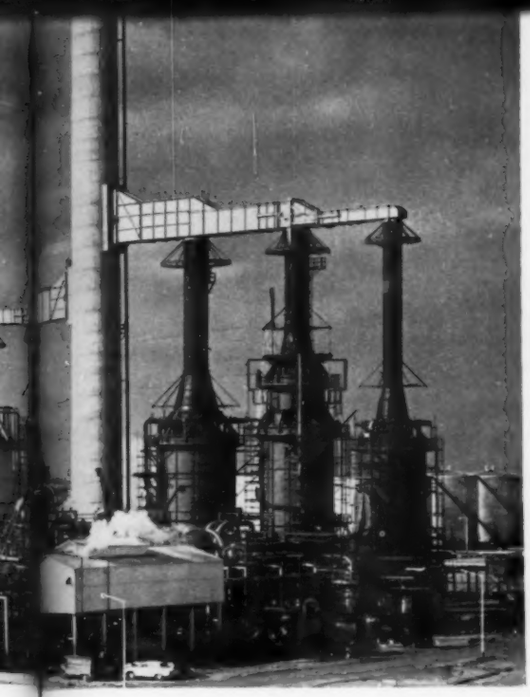
The new refinery will take about 20% of its crude oil supply directly from wells in the Netherlands, about one half of the total Dutch production. In addition to the 100,000 b/d crude distillation unit, basic downstream processing includes Powerforming, Hydrofining, and treating and blending. Beyond this, there are rail, docking, and offsite facilities. Approximately five million tons of gasoline, fuel oil, and diesel oil will be produced annually.

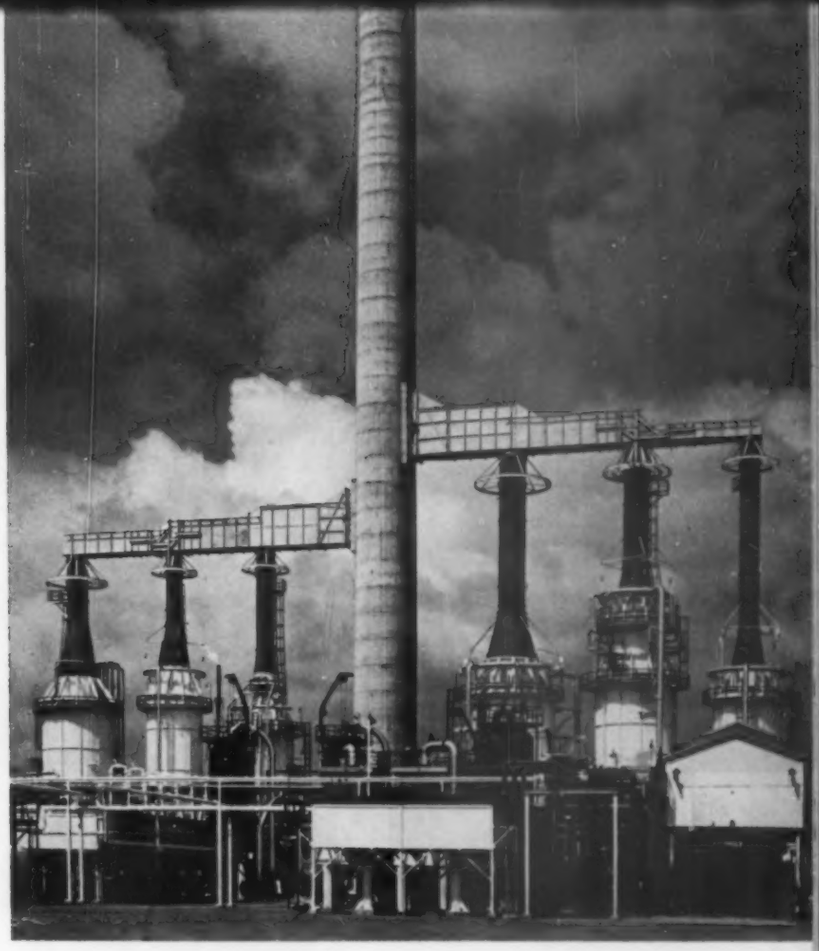
The plant is regarded as one of the most modern in Europe. It includes total electronic instrumentation with a central control room and graphic panel, airfin cooling system using variable pitch propellers, floating roof storage tanks, and an efficient method of loading barges.

One of the first refineries on the European continent to be equipped throughout with electronic controls, the plant will have an electronic system which will make possible more accurate measurement of storage tank content and temperature. Not only will deviations of measurement be substantially smaller than are possible by conventional methods, but volume and temperature readings will be indicated and recorded



One of the two piers with marine facilities.





Powerforming unit at Rotterdam refinery.

in the control room. In addition, print-out cards will be used to indicate the volume of products shipped.

In the highly efficient barge loading facilities, barges will be moored at a finger pier where they can receive products in relatively fast loading time. Ship-to-shore telephone installations and a vacuum tube system will expedite physical distribution of loading instructions and papers.

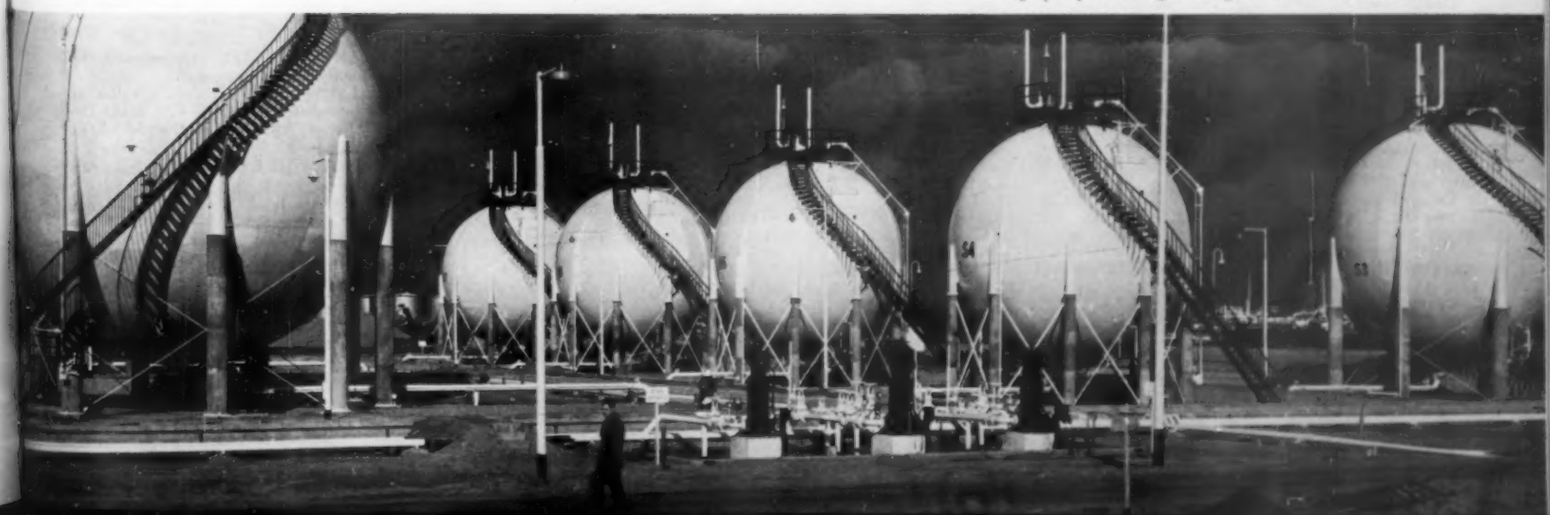
The refinery location is a particularly favorable one. Close to Rotterdam, the largest port in Europe, and the center of a net-work of canals extending all over Holland, it is at the mouth of the Maas River which is the outlet of the main artery of Europe, the Rhine, and only a few miles from the North Sea with its ocean-wide sources of import and export markets.

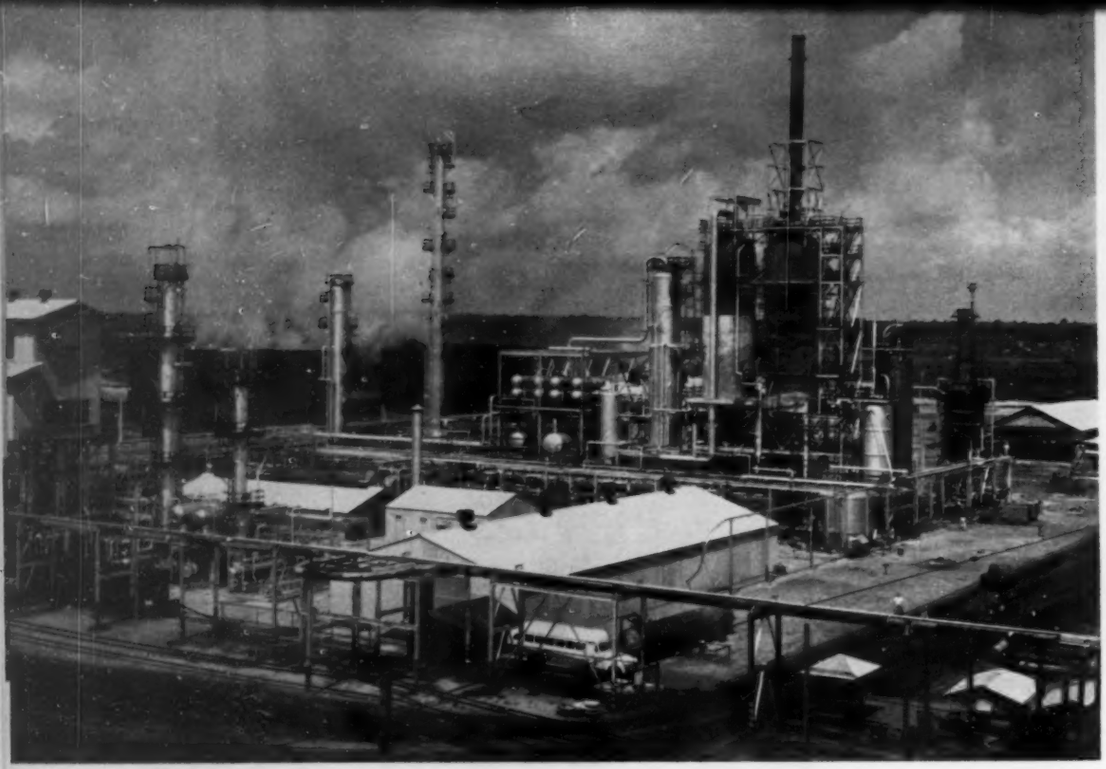
The main drawback to the site was that the refinery could not be built below river level. This problem was solved by pumping 10 million cu yards of sand (five million tons) from the river bed onto the site. This operation brought the location from its original 0.5 meter above the New Amsterdam Level to 5 meters above N.A.L.

Prime contractor for engineering, procurement services, and construction was Badger N.V., Netherlands subsidiary of Badger Mfg. Co., working with Esso Research and Engineering Co. on design.

Principal sub-contractors included the following concerns: civil work, N.V. Amsterdamsche Ballast Mij.; cylindrical heaters, Birwelco Ltd.; insulation, N.V. Inter. Tech. Handelmij. v/h Fa. F. J. Cleton; Pier I and Pier 11, Geerdink Aannemersbedrijf N.V.; piling, Hollandsche Beton Mij.; grading, Joh. Mourik & Co. Aannemers Mij. N.V.; barge terminal, Bouwbedrijf der Kon. Nederlandsche Mij. voor Havenwerken N.V.; electrical work, Van Rietschoten & Houwens Electrotechnische Mij. N.V.; and mechanical work, Werkspoor N.V. END

Liquefied petroleum gas storage tank area at Rotterdam.





Stanvac's Fluid catalytic cracking unit at Sungei Gerong, Indonesia, a 6,140 b/d plant, was the first cat cracker in southeast Asia. An $8 million installation, it was placed on stream in 1957.

The world's processing plants

BEGINNING on this page, the editors of WORLD PETROLEUM are pleased to present a complete directory of the world's petroleum refineries and the world's petrochemical plants.

Included are all facilities—presently operating, planned, or under construction — in all countries outside the USA but including the USSR and other communist nations where reliable information was obtainable.

The first section, starting below, is on refineries; immediately following it are the world's petrochemical plants. For convenience, the plants have been arranged alphabetically by company name under each specific country in which they are located. The following arrangement has been used for geographical areas:

Western hemisphere: North America, Central America and the Caribbean, South America.

Eastern hemisphere: Western Europe, Africa, Middle East, Asia and the Far East, USSR and satellites.

A summary and forecast on the world's processing situation today, along with pertinent tables covering capacities and investments, appears earlier in this issue of WORLD PETROLEUM.

North America

Canada

ANGLO AMERICAN EXPLORATION LTD. Hartell, Alberta. General superintendent, C. K. Carr.

Crude capacity: 4,000 b/sd. Vacuum distillation, 400 b/sd. Thermal cracking, 1,400 b/sd. Atlantic Catforming, 1,000 b/sd, with sulfur removal. Polymerization, 60 b/sd. Perco liquid copper treating, 1,200 b/sd.

ANGLO-CANADIAN OILS LTD. Brandon, Manitoba. Vice President and refinery manager, A. C. Morrison.

Crude capacity: 3,000 b/d. Thermal cracking, 1,400 b/d. Platforming, 1,000 b/d. Polymerization, 50 b/d. Caustic wash. Inhibitor sweetening.

BRITISH AMERICAN OIL CO. LTD. Calgary, Alberta. Manager, M. T. Stevens.

Crude capacity: 7,500 b/sd. Vacuum distillation, 2,500 b/sd. Thermal cracking, 2,500 b/sd. Atlantic Catforming, 3000 b/sd. Tannin Solutizer, Doctor treating, caustic washing. Asphalt, 600 b/sd (str. run) and 300 b/sd (oxidation).

Expansion of crude capacity to 10,000 b/d, to be completed in fall of 1960, will include a 3,500 b/d naphtha desulfurization unit.

BRITISH AMERICAN OIL CO. LTD. Clarkson, Ont. Manager, W. E. Lundie.

Crude capacity: 61,500 b/sd. Vacuum distillation, 20,000 b/sd. Thermal cracking, 4,500 b/sd. Orthoflow Model B catalytic cracking, 11,500 b/sd (fresh feed). Atlantic Catforming, 10,000 b/sd. Hydrodesulfurization 12,000 b/sd. Polymerization, 1,260 b/sd. Distillate desulfurization, 8,000 b/sd. Alkylation, 3,000 b/sd. Caustic treating. Clay contacting. Salt drying of distillate. Lubes, 1,220 b/sd. Asphalt, 4,000 b/sd (str. run) and 1,300 b/sd. (oxid.).

BRITISH AMERICAN OIL CO. LTD. Edmonton, Alberta. Manager, R. E. Harris.

Crude capacity: 8,500 b/sd. Thermal cracking, 2,500 b/sd. Delayed coking, 2,100 b/sd (65 ton/day). Model A Orthoflow catalytic cracking, 2,000 b/sd. Atlantic Catforming, 6,300 b/sd. Desulfurization, 6,300 b/sd. Bauxite treating (kerosine), 500 b/sd.

BRITISH AMERICAN OIL CO. LTD. Montreal East, Que. Manager, J. A. McHardy.

Crude capacity: 50,000 b/sd. Vacuum distillation, 17,000 b/sd. Decarbonizing, 5,500 b/sd. Fluid catalytic cracking, 22,000 b/sd. Atlantic Catforming, 13,000 b/sd plus hydrodesulfurization, 17,000 b/sd. Polymerization, 630 b/sd. Asphalt, 9,000 b/sd (str. run) and 3,000 b/sd oxidation. Lubes, 330 b/sd.

BRITISH AMERICAN OIL CO. LTD. Moose Jaw, Saskatchewan. Manager, B. A. Barnhill.

Crude capacity: 15,000 b/sd. Vacuum distillation, 5,500 b/sd. Thermal cracking, 1,500 b/sd. Delayed coking, 2,250 b/sd (100 ton/day). UOP Fluid catalytic cracking, 4,500 b/sd. Atlantic Catforming, 5,400 b/sd. Hydrodesulfurization, 6,500 b/sd. Polymerization, 390 b/sd. Caustic washing. Salt drying of distillate. Asphalt, 1,200 b/sd.

BRITISH AMERICAN OIL CO. LTD. Port Moody, British Columbia. Manager, C. W. Coote.

Crude capacity: 20,000 b/sd. Vacuum distillation, 9,000 b/sd. Model B Orthoflow catalytic cracking, 9,000 b/sd. Sinclair-Baker catalytic reforming, 4,000 b/sd plus hydrodesulfurization, 7,200 b/sd. Sulfuric acid alkylation, 1,050 b/sd. Distillate desulfurization, 4,000 b/sd. Caustic wash. Petreco electrical caustic wash.

BRITISH PETROLEUM CANADA LTD. Ville d'Anjou, near Montreal, Que. General manager, J. MacWilliam.

Crude capacity: 25,000 b/sd. Fluid catalytic cracking, 9,000 b/sd. Platforming, 6,000 b/sd. Desulfurization (distillate), 12,000 b/sd. Polymerization, 800 b/sd. Treating (amine, copper chloride, and caustic).

New refinery, completed this spring at cost of $30 million, by Lummus Co. of Canada Ltd.

CANADIAN HUSKY OIL LTD. Fort William, Ont. Superintendent, F. D. Stevens.

Crude capacity: 3,800 b/sd. Vacuum distillation, 1,300 b/sd. Atlantic Catforming, 1,000 b/sd. Diesulforming (middle distillate), 1,000 b/sd. Asphalt, 820 b/sd.

CANADIAN HUSKY OIL LTD. Lloydminster, Alberta. Superintendent, L. W. Cavanagh.

Crude capacity: 8,500 b/sd. Vacuum distillation, 2,100 b/sd. Cycloversion reforming, 400 b/sd. Desulfurization, 1,000 b/sd. Asphalt oxidation, 900 b/sd.

CANADIAN HUSKY OIL LTD. Moose Jaw, Saskatchewan. Superintendent, R. L. Miller.

Crude capacity: 3,200 b/sd. Vacuum distillation, 1,300 b/sd. Atlantic Catforming, 650 b/sd. Visbreaking, 1,300 b/sd. Diesulforming, 1,000 b/sd. Asphalt, 900 b/sd.

CANADIAN KODIAK REFINERIES LTD. Lloydminster, Alberta. General manager, J. Moar.

Crude capacity: 4,000 b/d. Vacuum distillation, 2,350 b/d. Asphalt oxidation, 2,000 b/d. Petreco dehydrating and desalting

Construction plans include production of jet fuel

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Cast Steel Swing Check Valve

Cast Steel Wedge Gate Valve, Series 300

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Mark III Super Valve, Butt Welding

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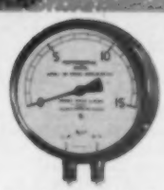

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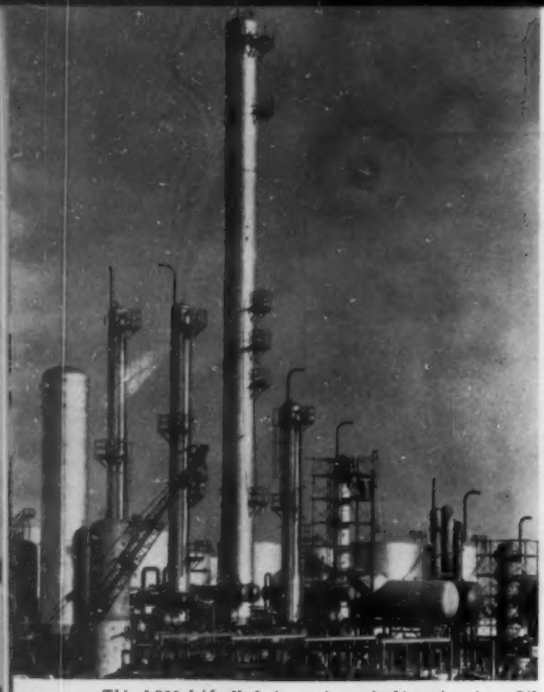


This 1,200 b/d alkylation unit at Arabian American Oil Co.'s Ras Tanura, Saudi Arabia, refinery went into operation last year.

using hydrogen from gas condensate treatment to treat black oil overhead and desulfurize end product.

CANADIAN OIL COS. LTD. Corunna, near Sarnia, Ontario. Manager, V. M. Norwood.

Crude capacity: 50,000 b/sd. Vacuum distillation, 15,000 b/sd. Visbreaking, 3,500 b/sd. Orthoflow catalytic cracking, 12,000 b/sd (fresh feed). Platforming for motor fuel, 6,000 b/sd (4,500 b/sd for Udex extraction). Polymerization, 2,000 b/sd (feed), 700 b/d (products). Unifining, 5,000 b/d. Merox and Doctor treating. Caustic washing.

CANADIAN OIL COS. LTD. Innisfail field, near Red Deer, Alberta.

Under construction: $4 million plant to operate on 4,000 b/d of gas condensate (and 2,000 b/d of crude oil as supplementary feed). Facilities will include: fractionation, Platforming, and hydrodesulfurization.

Completion by Canadian Bechtel Ltd. late fall, 1960.

CANADIAN PETROFINA LTD. Pointe-aux-Trembles, near Montreal, Quebec. Superintendent, J. F. Mills.

Crude capacity: 30,000 b/d. Vacuum distillation, 14,500 b/d. Fluid coking, 3,800 b/d (80 ton/day). Houdriflow catalytic cracking, 12,000 b/d (fresh feed). Ultraforming, 4,500 b/d. Polymerization, 450 b/d. Sulfuric acid alkylation, 1,500 b/d. Shell Trickle hydrodesulfurization (fuel oil), 4,000 b/d. Hydrofining, 4,500 b/d. Linde gasoline treating.

Under construction: asphalt plant.

CITIES SERVICE REFINING LTD. CANADA. Bronte, Ontario. Superintendent, A. A. Forter.

Crude capacity: 20,000 b/d. Vacuum distillation, 8,200 b/d. UOP Fluid catalytic cracking, 7,000 b/d. Sinclair-Baker catalytic reforming, 3,500 b/d. Hydrodesulfurization. Bender sweetening. Caustic treating. Amine treating.

CONSUMERS' COOPERATIVE REFINERIES LTD. Regina, Saskatchewan. Manager, B. W. Pawson.

Crude capacity: 16,000 b/sd. Vacuum distillation, 6,500 b/sd. Delayed coking, 3,000 b/sd (145 ton/day). UOP Fluid catalytic cracking, 5,000 b/sd. Polymerization, 500 b/sd. Treating (caustic, Perco, Doctor).

Under construction: a 3,000 b/d Platformer-Unifiner and 6,000 b/d distillate Unifiner, for completion Dec. 31, 1960. Cost $2.75 million.

GOLDEN EAGLE REFINING CO. OF CANADA, a wholly owned subsidiary of Ultramar Co. has signed an agreement with the provincial government of Newfoundland to build a new refinery at St. Johns, with an initial capacity of at least 5,000 b/d. No further information has as yet been disclosed. Ultramar recently acquired Panama Refining & Petrochemical Co. along with its refining subsidiary, Golden Eagle Refining Co., which operates a 9,000 b/d plant in Torrance, Calif.

IMPERIAL OIL LTD. Calgary, Alberta. Manager, S. T. Reynolds.

Crude capacity: 14,700 b/d. Vacuum distillation, 5,400 b/d. Thermal cracking, 4,600 b/d. Model IV Fluid catalytic cracking, 7,000 b/d. Powerforming, 3,000 b/d. Sulfuric acid alkylation, 870 b/d. Treating. Asphalt, 725 b/d.

IMPERIAL OIL LTD. Edmonton, Alberta. Manager, E. K. Lewis.

Crude capacity: 28,500 b/d. Vacuum distillation, 6,000 b/d. Thermal cracking, 9,100 b/d. Model IV Fluid catalytic cracking, 8,000 b/d. Powerforming, 2,000 b/d. Hydrofining, 2,700 b/d. HF alkylation, 1,500 b/sd. Lubes, 2,000 b/d.

IMPERIAL OIL LTD. Halifax, Nova Scotia. Manager, M. MacLeod.

Crude capacity: 49,000 b/d. Vacuum distillation, 24,000 b/d. Model IV Fluid catalytic cracking, 13,500 b/d. Powerforming, 6,300 b/d. Hydrofining, 4,900 b/d. Polymerization, 4,500 b/d (feed), 2,000 b/d (products). Asphalt, 1,850 b/d.

IMPERIAL OIL LTD. Ioco, British Columbia. Manager, Harry L. Cavanagh.

Crude capacity: 32,000 b/d. Vacuum distillation, 13,600 b/d. Model IV Fluid catalytic cracking, 7,600 b/d. Powerforming, 5,000 b/d. Polymerization, 2,340 b/d (feed), 1,125 b/d (products). Hydrofining, 3,850 b/d. Asphalt, 1,370 b/d. Treating (lye, Doctor, Potasol).

IMPERIAL OIL LTD. Montreal East, Quebec. Manager, J. J. Rowan.

Crude capacity: 71,800 b/d. Vacuum distillation, 35,500 b/d. Model IV Fluid catalytic cracking, 19,500 b/d. Powerforming, 9,450 b/d. Visbreaking, 10,500 b/d. Polymerization, 5,000 b/d (feed), 2,300 b/d (products). Hydrofining, 7,000 b/d. Asphalt, 4,650 b/d. Treating.

IMPERIAL OIL LTD. Norman Wells, North West Territories. Manager, J. S. L. McMillan.

Crude capacity: 1,350 b/d. Products: aviation and motor gasolines, middle distillates, fuel oils.

IMPERIAL OIL LTD. Regina, Saskatchewan. Manager, A. Garfield Stewart.

Crude capacity: 22,500 b/d. Vacuum distillation, 10,700 b/d. Thermal cracking, 4,500 b/d. Model IV Fluid catalytic cracking, 8,500 b/d. Powerforming, 3,000 b/d. Polymerization, 2,000 b/d (feed), 1,000 b/d (products). Asphalt, 550 b/d. Treating (caustic, copper chloride, Doctor).

IMPERIAL OIL LTD. Sarnia, Ontario. Manager, G. R. McMillin.

Crude capacity: 94,500 b/d. Vacuum distillation, 30,000 b/d. Thermal cracking, 4,000 b/d. Thermal reforming, 8,000 b/d. Delayed coking, 28,000 b/d (25 ton/day). Model IV Fluid catalytic cracking, 20,000 b/d. Powerforming, 15,000 b/d. Visbreaking, 4,000 b/d. Alkylation, 1,500 b/d. Asphalt, 2,300 b/d. Hydrofining, 3,800 b/d. Caustic, copper chloride and Doctor treating. Lubes, 3,200 b/d.

IMPERIAL OIL LTD. Winnipeg, Manitoba. Manager, H. F. Wheaton.

Crude capacity: 18,000 b/d. Vacuum distillation, 7,300 b/d. Model IV Fluid catalytic creacking, 6,500 b/d. Powerforming, 3,400 b/d. Hydrofining, 2,500 b/d. HF alkylation, 650 b/sd. Asphalt, 1,100 b/d. Treating processes.

IRVING REFINING LTD. St. John, New Brunswick. President, Lee C. Henning.

Crude capacity: 40,000 b/d. Fluid catalytic cracking, 13,000 b/d. Catalytic reforming, 7,200 b/d. Hydrodesulfurization, 5,000 b/d. Hydrotreating, 2,500 b/d. Hydrogen manufacture, approx. 3 mmcf/d.

New refinery, completed this spring by Canadian Bechtel Ltd. at cost of $45 million.

NEW BRUNSWICK OILFIELDS LTD. Weldon, New Brunswick.

Crude capacity: 300 b/d. Products, gasoline and fuel oils.

NORTH STAR OIL LTD. Grande Prairie, Alberta. Superintendent, W. Campbell.

Crude capacity: 2,500 b/d. Thermal cracking, 900 b/d. Sinclair-Baker catalytic reforming and desulfurization, 850 b/d. Linde treating, 1,000 b/d.

NORTH STAR OIL LTD. St. Boniface, near Winnipeg, Manitoba. Manager, W. J. Dubesky.

Crude capacity: 12,000 b/sd. Vacuum distillation, 4,860 b/sd. Model B Orthoflow catalytic cracking, 5,200 b/sd. Platforming, 2,700 b/sd. Unifining (naphtha), 2,700 b/sd. Polymerization, 390 b/sd. Merox treating (naphtha) 2,200 b/sd. Caustic washing.

NORTHERN PETROLEUM CORP. LTD. Kamsack, Saskatchewan. General manager, J. B. Lloyd.

Crude capacity: 1,000 b/sd. Treating (caustic and copper chloride).

REGENT REFINING (CANADA) LTD. Port Credit, Ontario. Superintendent, L. W. Kennedy.

Crude capacity: 20,000 b/d. Vacuum distillation, 9,200 b/d. UOP Fluid catalytic cracking, 7,000 b/d. Platforming, 2,100 b/d. Polymerization, 660 b/d. Visbreaking 3,600 b/d. Doctor and inhibitor sweetening. Caustic wash.

New construction: New 5,400 b/d, $1.5 million, catalytic reformer and conversion of existing Platformer to a 5,400 b/d desulfurizing unit. Completion date: September, 1960.

ROYALITE HI-WAY LTD. Saskatoon, Saskatchewan. Superintendent, J. C. Browning.

Crude capacity: 8,000 b/d. Vacuum visbreaker, 3,780 b/d. Thermal cracking, 1,600 b/d. Catalytic cracking, 2,600 b/d. Polymerization, 620 b/d (feed), 250 b/d (products). Perco desulfurization, 2,000 b/d. Caustic wash and inhibitor sweetening. Asphalt, 300 b/d.

ROYALITE OIL CO. LTD. Kamloops, British Columbia. Superintendent, J. Wach.

Crude capacity: 5,000 b/d. Vacuum distillation, 2,180 b/sd. UOP Fluid catalytic cracking, 1,400 b/d. Platforming, 1,000 b/d. Polymerization, 100 b/d. Asphalt, 700 b/d.

SHELL OIL CO. OF CANADA LTD. Montreal East, Quebec. Manager, G. A. Lorenz.

Crude capacity: 62,000 b/sd. Vacuum distillation, 33,000 b/sd. Thermal cracking, 7,000 b/sd. Visbreaking, 7,500 b/sd. Fluid catalytic cracking, 22,000 b/sd. Platforming, 7,500 b/sd. Polymerization, 3,600 b/sd (feed), 1,200 b/d (products). HF alkylation, 1,500 b/sd. Shell Trickle hydrodesulfurization, 9,000 b/sd. Linde treating, 8,000 b/sd. Solutizer, 14,000 b/sd. Asphalt, 6,000 b/sd.

New construction: crude desalter, distillate treating (electrostatic), and catalytic reformer revamp.

SHELL OIL CO OF CANADA LTD. North Burnaby, British Columbia. Manager, A. C. Hogge.

Crude capacity: 20,000 b/d. Vacuum distillation, 8,000 b/d. Thermal cracking, 4,500 b/d. UOP Fluid catalytic cracking, 6,000 b/d (fresh feed). Platforming, 3,300 b/d. Polymerization, 400 b/d. Unifining, 3,300 b/d. Solvent and specialties unit, 1,000 b/d. Shell hydrodesulfurization (distillates), 9,300 b/d. Doctor treating (cat cracked gasoline), 3,000 b/d. Air solutizer (str. run gasoline), 3,500 b/d. Asphalt 2,000 b/d.

SHELL OIL CO. OF CANADA LTD. has purchased property near Bronte, Ontario. No definite plans have been announced, but a new 20,000 b/d refinery is being considered as a possibility for 1961-62.

SHELL OIL CO. OF CANADA LTD. has taken an option on 310 acres near Calgary, Alta. for the possible construction of a new refinery. No further information has been disclosed.

STANDARD OIL CO. OF BRITISH COLUMBIA LTD. North Burnaby, British Columbia. Manager, V. Wiebe.

Crude capacity: 18,900 b/sd. Vacuum distillation, 8,000 b/sd. Model IV Fluid catalytic cracking, 9,900 b/sd (total feed). Platforming, 3,000 b/d. Polymerization, 450 b/sd (products). Copper chloride and caustic washing. Asphalt, 2,000 b/d.

SUN OIL CO. LTD. Sarnia Ontario. Manager, F. A. Bain.

Crude capacity: 15,000 b/d. Houdriflow catalytic cracking, 11,500 b/d. Houdriforming, 3,000 b/d. Visbreaker, 3,300 b/d. Perco kerosine sweetening, 2,000 b/d. Caustic wash for gasoline with Howe-Baker electric coalescer.

TEXACO CANADA LTD. Edmonton, Alberta. Superintendent, H. M. Williams.

Crude capacity: 12,000 b/d. Delayed coking, 2,000 b/d (60 ton/day). Thermal cracking, 2,700 b/d. Fluid catalytic cracking, 4,000 b/d. Platforming, 3,000 b/d. Polymerization, 750 b/d. Linde treating.

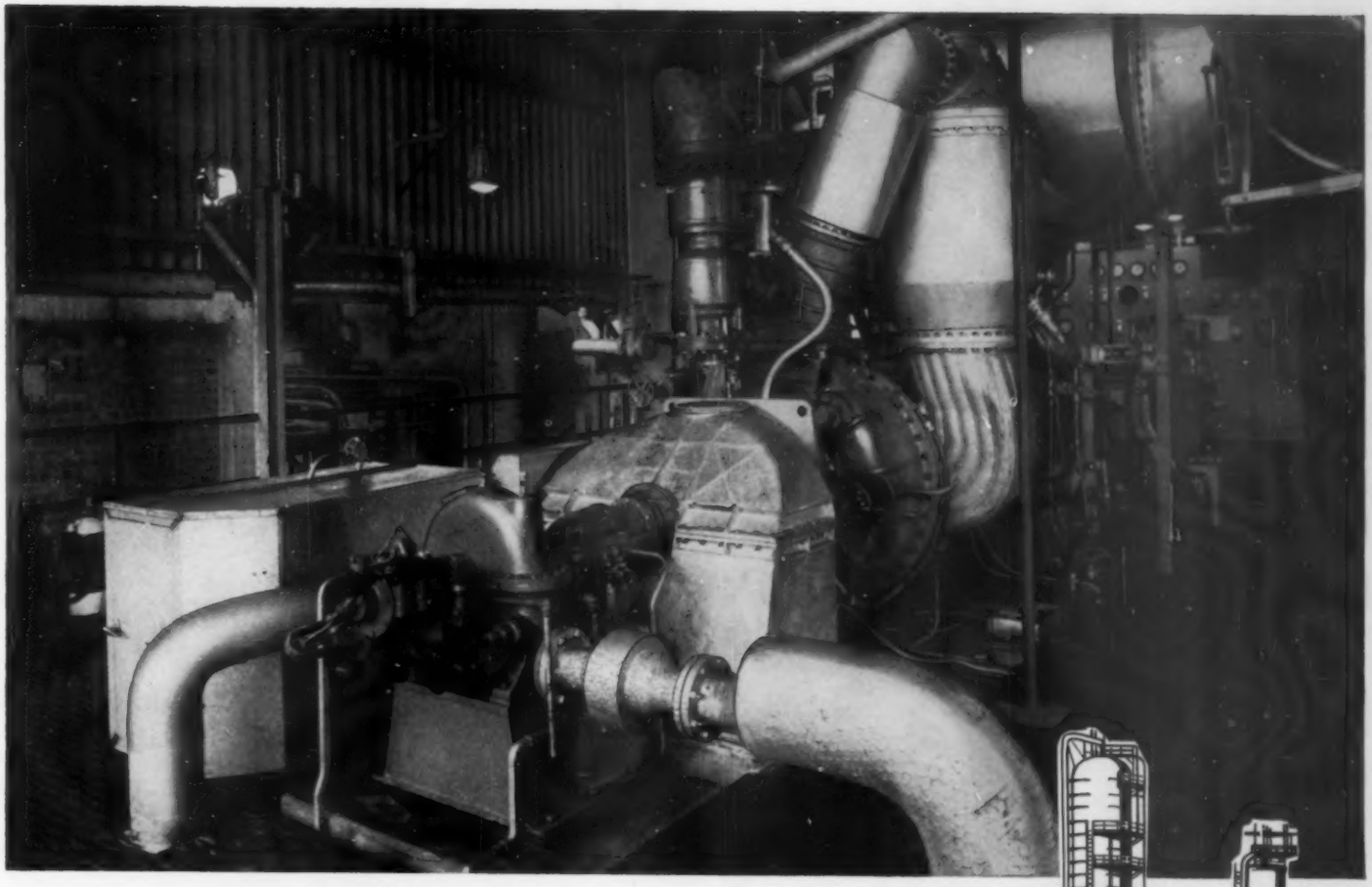
TEXACO CANADA LTD. Montreal East, Quebec. Superintendent, H. M. Bolitho.

Crude capacity: 59,000 b/d. Vacuum distillation, 30,000 b/d. Fluid catalytic cracking, 20,000 b/d. Platforming, 11,000 b/sd. Polymerization, 4,500 b/d (feed), 1,500 b/d (products). Hydrotreating, 9,000 b/d. Linde treating, 24,200 b/d. Sulfuric acid alkylation, 2,000 b/d.

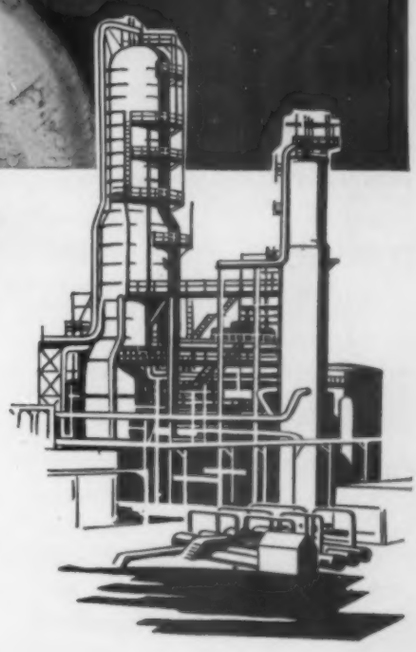
WAINWRIGHT PRODUCERS & REFINERS LTD. Wainwright, Alberta. General manager, R. I. Petrie.

Crude capacity: 5,000 b/d. Vacuum distillation, 1,500 b/d. Visbreaking, 600 b/d. Treating (Doctor, caustic wash, and salt drying of distillate).

Construction: new 3,000 b/d Thermal cracking unit and 1,000 b/d Platformer. Contractor: Ralph M. Parsons Co.



On duty 24 hours every day at Fawley



This 'ENGLISH ELECTRIC' gas turbine operates continuously for twenty-four hours every day in the Esso petro-chemical plant at Fawley Refinery—without a standby.

It is direct-coupled to a propylene refrigeration compressor on the butadiene extraction unit and delivers 2,625 h.p. to the compressor coupling at a shaft speed of 7,500 r.p.m. Waste heat from the turbine is used to raise 18,000 lb/hr of low pressure steam at 125 lb. gauge, for general refinery services.

Auxiliary equipment is flameproofed where necessary for working in a hazardous area.

'ENGLISH ELECTRIC'

LONG-LIFE

industrial gas turbines

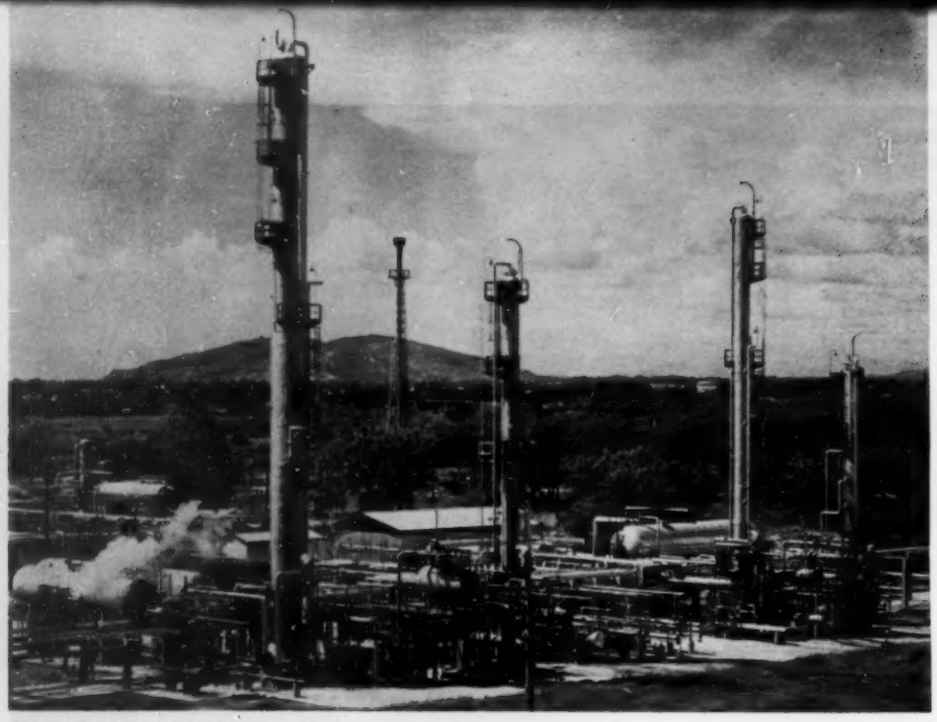
from 2,300 h.p. (1,600 kW)

THE ENGLISH ELECTRIC COMPANY LIMITED, MARCONI HOUSE, STRAND, LONDON, W.C.2

Gas Turbine Division, Whetstone, Leicestershire

WORKS: STAFFORD · PRESTON · RUGBY · BRADFORD · LIVERPOOL · ACCRINGTON

GT7A



Chinese Petroleum Co.'s Kaohsiung, Taiwan, refinery. Unit shown is a 900 b/sd sulfuric acid alkylation unit.

X-L REFINERIES LTD. Dawson Creek, British Columbia. Superintendent, S. D. Lathrop.
Crude capacity: 2,000 b/d. Vacuum distillation, 1,350 b/d. Thermal cracking, 1,000 b/d. Houdriforming, 500 b/d. Hydrotreating, 500 b/d. Treating (caustic, copper slurry, and inhibitors). Asphalt, 350 b/d.

Mexico

PETROLEOS MEXICANOS. Arbol Grande, Tampico. Plant Manager, J. B. Aguilar.
Crude capacity: 26,000 b/d. Grease manufacture.

PETROLEOS MEXICANOS. Atzcapotzalco, Mexico City.
Crude capacity: 100,000 b/d. Thermal cracking, 14,500 b/d. Model IV Fluid catalytic cracking, 25,000 b/d. Alkylation, 3,000 b/d. Desulfurization, 29,000 b/d. Polymerization, 800 b/d.

PETROLEOS MEXICANOS. "Madero" refinery, Tampico. Gen'l Ref'y. sup't., Francisco L. Corcuera.
Crude capacity: 120,000 b/d. Vacuum distillation, 60,000 b/d. Visbreaking, 9,000 b/d. Fluid catalytic cracking, 25,000 b/d. Perco Cycloversion, 15,000 b/d. Perco desulfurization, 18,000 b/d. Polymerization, 2,000 b/d. Treating, 10,000 b/d. Asphalt, 5,000 b/d. Wax, 40 ton/day. Sulfur recovery, 30 ton/day.
Expansion plans are for a completely new $45 million, 135,000 b/d refinery in Tampico to replace eventually all three present facilities. The present 120,000 b/d capacity at Madero represents the first phase of this program.

PETROLEOS MEXICANOS. Mata Redonda, Tampico.
Crude capacity: 12,000 b/d. Thermal cracking, 6,000 b/d.

PETROLEOS MEXICANOS. Minatitlan.
Crude capacity: 85,000 b/d. Thermofor catalytic cracking, 10,000 b/d. Visbreaking, 6,500 b/d. Polymerization, 1,400 b/d. Lubes, 800 b/d.
Construction: a new topping unit of 50,000 b/d capacity, for completion mid-1961.

PETROLEOS MEXICANOS. Poza Rica.
Crude capacity: 6,000 b/d.
Under construction: a new 15,000 b/d topping unit and Perco catalytic reforming.

PETROLEOS MEXICANOS. Reynosa.
Crude capacity: 10,000 b/d. Thermal cracking, 1,500 b/d. Natural gas plant, 300 mmcf/d.
Gas plant is being enlarged to 600 mmcf/d.

PETROLEOS MEXICANOS. Salamanca. Plant manager, Jose Muro Lozano.
Crude capacity: 40,000 b/sd. Vacuum distillation, 14,000 b/sd. Thermal cracking, 6,000 b/sd. Perco desulfurization, 11,000 b/sd. MEK dewaxing, 3,000 b/sd. Propane deasphalting, 5,800 b/sd. Furfural extraction, 6,000 b/sd. Wax percolation, 900 b/sd. Clay contacting, 2,300 b/sd.

Expansion in crude capacity to 80,000 b/d is planned. Also planned: a 15,000 b/d Thermofor catalytic cracking unit, and a new grease plant.

Central America and Caribbean

Barbados

BARBADOS UNION OIL CO. LTD., Bridgetown, Barbados, has modernized its refinery, installing a 1,000 b/d (design capacity) crude still, and vacuum distillation for asphalt production. Mobil International Oil Co. purchased an interest in this company early in 1960.

Cuba

BACURANAO REFINERY. Bacuranao, Havana, Cuba.
Crude capacity: 300 b/d topping.

COMPAÑIA PETROLERA SHELL DE CUBA, S.A. Havana, Cuba. Refinery manager, William Lammers.
Crude capacity: 27,000 b/d. Platformer, 5,500 b/d.

COPETROL OIL REFINING CO. Cardenas, or Nuevitas, Cuba.
A new 18,000 b/d refinery has been planned for either of these two sites, with expected completion in 1961.

CORPORATION GENERAL DE PETROLEO REFINERIA CABAIGUAN. Jatibanico, Cuba.
Crude capacity: 1,000 b/d.

ESSO STANDARD OIL CO. S.A. Belot, Cuba. Manager, F. L. Fourrier.
Crude capacity: 35,000 b/d. Vacuum distillation, 22,140 b/sd. Fluid catalytic cracking, 14,570 b/sd (fresh feed). Powerforming, 2,400 b/d. Hydrofining, 2,400 b/d. Polymerization, 1,000 b/d. Lubes, 200 b/d. Grease, 3.2 million lb/yr.

PETROLERA JARAHUECA S.A. Jarahueca, Cuba.
Crude capacity: 200 b/d.

REFINERIA CABAIGUAN. Cabaiguan, Cuba. President, Dr. Fernando Prado Garcia.
Crude capacity: 2,500 b/sd. Thermal cracking, 600 b/sd.

SANTO MARIO OIL REFINING CO. Cotorro, Havana, Cuba.
Crude capacity: 600 b/d topping plant.

THE TEXAS CO. (WEST INDIES) LTD. Santiago de Cuba, Cuba. Plant manager, C. M. Cutbirth.
Crude capacity: 20,000 b/d. Platforming, 3,300 b/d. Hydrotreating, 4,100 b/d. Linde gasoline treating, 1,500 b/d.

Guatemala

MATIAS DE GALVEZ LTD., owned jointly by Shell Oil and Breaux Bridge Oil Refining Co. Puerto Barrios, Izabal, Guatemala.
A new 3,500 b/d refinery is being built, with completion expected in 1961. Lummus Co. has contract.

REFINERIA PETROLEOS DE GUATEMALA, S.A. plans a 12,000 b/d, $18 million refinery near Matias de Galvez. New company is seeking government approval on behalf of a group headed by Phillips Petroleum Co. Products are to include regular and high octane gasoline, kerosine, diesel fuel, fuel oil, asphalt and LPG.

Honduras

A 15,000 b/d refinery plan is reported to be up for government approval at an undisclosed site in Honduras.

Jamaica

JAMAICA OIL & CHEMICAL CO. plans a new 7,500 b/d refinery near Kingston, Jamaica, with completion expected this year or 1961, and with later expansion to 15,000 b/d. Colorado Oil & Gas Co. holds a large interest in this company.

Nicaragua

A 10,000 b/d refinery is said to be planned for an undisclosed site in Nicaragua. No further information is available.

Panama

REFINERIA PANAMA S.A. is building a 55,000 b/d, $40 million refinery at Las Minas, Panama. Completion date early 1961.

REFINERIA PETROQUIMICA DE PANAMA S.A. Portobelo Harbor, Panama.
A new 60,000 b/d $59 million refinery is scheduled for construction, with completion this year.

Puerto Rico

CARIBBEAN REFINING CO. San Juan, Puerto Rico. Vice President, mfg., Eugene G. Case.
Crude capacity: 15,000 b/d. Vacuum distillation, 10,000 b/d. UOP Fluid catalytic cracking, 8,500 b/d. Polymerization, 1,200 b/d.

COMMONWEALTH OIL REFINING CO. INC. Ponce, Puerto Rico. Plant manager, C. W. Brackin.
Crude capacity: 75,000 b/d. Vacuum distillation, 48,700 b/d. Visbreaking, 20,000 b/d. Houdry catalytic cracking, 53,600 b/d. Houdriforming, 7,460 b/d. Unifining, 10,000 b/d. Polymerization, 4,500 b/d. Sulfuric acid alkylation, 1,400 b/d. SO_2 extraction, kerosine, 4,400 b/d. Howe-Baker treating, gasoline, 2,000 b/d.

El Salvador

EL SALVADOR GOVERNMENT has approved one bid and is expected to act on two others for refineries. Bid approved was from joint USA, British, and local capital. Awaiting action are a bid from Esso and another from Royal/Dutch Shell.

South America

Argentina

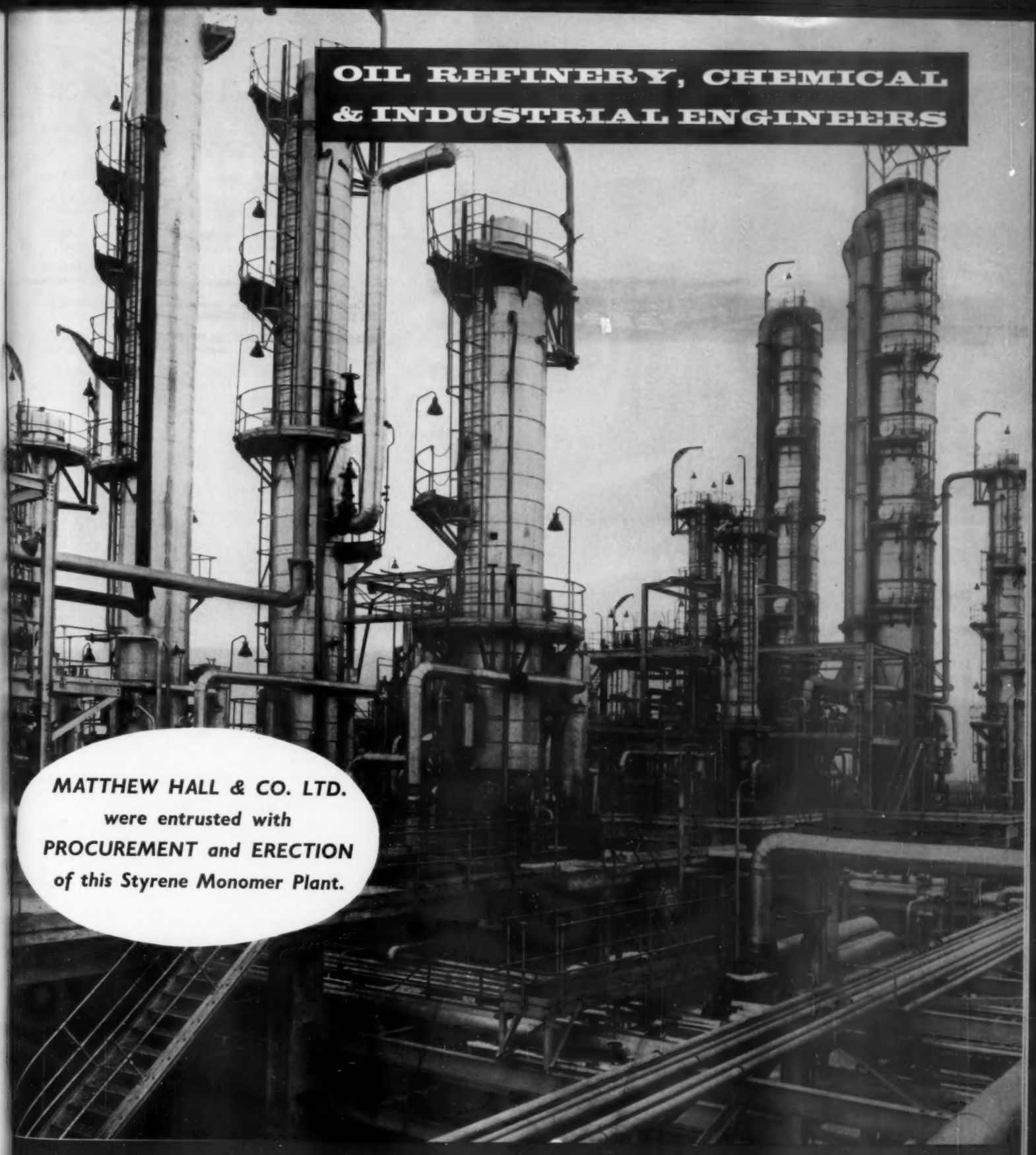
CIA CONDOR. Avellaneda, Argentina.
Crude capacity: 900 b/d.

CIA. GENERAL ASFALTOS. Wilde, Buenos Aires, Argentina.
Crude capacity: 400 b/d.

DIADEMA ARGENTINA S.A. DE PETROLEO. Buenos Aires, Argentina.
Crude capacity: 47,000 b/d. Thermal cracking, 17,000 b/d. Thermal reforming, 3,300 b/d. Solvent refining, 600 b/d.
Planned expansion: a new crude distillation unit, 35,000 b/d. Probable completion, early 1962.

ESSO S.A.P.A. Bahia Blanca, Argentina.
Crude capacity: 5,500 b/d. Thermal cracking, 2,500 b/d.

ESSO S.A.P.A. Compana (Buenos Aires) Argentina. Manager: A. E. London.
Crude capacity: 65,000 b/d. Vacuum distillation, 7,000 b/d. Thermal cracking, 22,000 b/d. Model IV Fluid catalytic cracking, 16,000 b/d. Solvent refining (lubes), 2,000 b/d. Clay treating, 300 b/d.



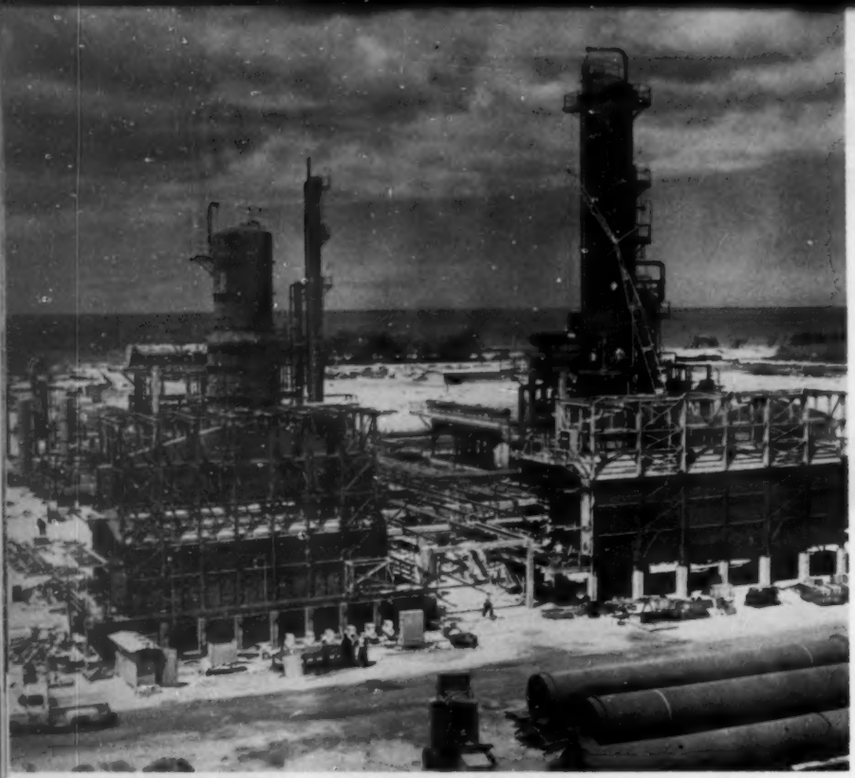
THE

MATTHEW HALL

GROUP OF COMPANIES

MATTHEW HALL HOUSE · PRINCE REGENT SQUARE

Glasgow · Cape Town · Wellington



New refinery rises in middle of Pacific Ocean. Standard Oil of California's plant on Hawaii. Two-stage crude still, with vacuum column and heater at left, atmospheric tower and heater on the right.

ESSO S.A.P.A., Manuel Elordi (Salte), Argentina.
Crude capacity: 1,300 b/d.

ESSO S.A.P.A., Plaza, Huincul, Argentina.
Crude capacity: 500 b/d.

LOTTERO Y PAPINI. Pineyro (Buenos Aires), Argentina.
Crude capacity: 500 b/d.

PETROQUIMICA (Y.P.F.). Comodoro Rivadavia, Argentina.
Crude capacity: 5,500 b/d. Thermal cracking, 2,000 b/d. Visbreaking.

REFINERÍA DE PETRÓLEO "LA ISAURA" S.A. Bahia Blanca, Argentina. General manager, José Manuel Elicabe.
Crude capacity: 2,000 b/d. Thermal cracking, 1,200 b/d.

YACIMIENTOS PETROLIFEROS FISCALES (Y.P.F.) Chachapoyas (Salta), Argentina. Manager, Claudio V. Bianco.
Crude capacity: 3,500 b/d. Thermal cracking, 1,300 b/d.
Planning a 3,150 b/d naphtha reformer.

Y.P.F. expects to complete a 19,000 b/d refinery at Campo Duran, Argentina, in 1962.

Y.P.F. Dock Sud—Avellaneda, Argentina. Manager, Ruben L. Antola.
Crude capacity: 6,000 b/d. Vacuum distillation, 2,200 b/d. Thermal cracking, 2,000 b/d. Lube oils, 340 b/d.

Y.P.F. La Plata, Argentina. Manager, Vicente García Cano.
Crude capacity: 100,000 b/d. Vacuum distillation, 7,000 b/d. Visbreaking, 16,000 b/d. Thermal cracking, 20,000 b/d. Catalytic cracking, 16,000 b/d. Alkylation, 5,500 b/d. Polymerization, 3,300 b/d. Lube oils, 530 b/d. Asphalt, 1,300 b/d.

Y.P.F. Lujan de Cuyo (Mendoza), Argentina. Manager, Gabriel Llamas.
Crude capacity: 14,000 b/d. Thermal cracking, 2,000 b/d. Visbreaking, 6,300 b/d.
Expansion of crude capacity to 40,700 b/d, and installation of a 16,600 b/d catalytic cracking unit and an 18,500 b/d delayed coking unit, will be completed in 1961, at a cost of $25 million. M. W. Kellogg is the prime contractor.

Y.P.F. Plaza Huincul (Neuquen), Argentina. Manager, C. A. de Ipola.
Crude capacity: 2,500 b/d. Thermal cracking, 500 b/d.

Y.P.F. San Lorenzo, Argentina. Manager, Luis J. Macario.
Crude capacity: 25,000 b/d. Thermal cracking, 6,000 b/d. Visbreaking, 6,000 b/d.
Expansion in crude capacity to 28,000 planned.

Bolivia

YACIMIENTOS PETROLIFEROS FISCALES BOLIVIANOS (YPFB). Camiri, Bolivia.
Crude capacity: 1,500 b/d.

YACIMIENTOS PETROLIFEROS FISCALES BOLIVIANOS. Cochabamba refinery, Cochabamba, Bolivia. Plant manager, Mario Balcázar Aranibar.
Crude distillation: 6,000 b/d. Doctor sweetening, 3,000 b/d. Light ends recovery, 2,000 b/d.

Y.P.F.B. Sanandita, Bolivia.
Crude capacity: 400 b/d.

Y.P.F.B. Sucre, Bolivia.
Crude capacity: 4,000 b/d.

Brazil

COMPANHIA DE PETROLEO DA AMAZONIA. Manaus, Amazonas, Brazil. Superintendent, H. Weiser.
Crude capacity: 6,500 b/sd. Vacuum distillation, 2,000 b/sd. Fluid catalytic cracking, 2,000 b/sd. Caustic treating, 5,000 b/sd.

DISTILLARIA RIO GRANDENSE DE PETROLEO, S.A. Rio Grande du Sul, Brazil.
Crude capacity: 300 b/d.

INDUSTRIAS MATARAZZO DE ENERGIE, S.A. Sao Paulo, Brazil.
Crude capacity: 500 b/d.

IPIRANGA S.A. CIA BRASILEIRA DE PETROLEO. Rio Grande, Brazil.
Crude capacity: 6,000 b/d. Thermal cracking, 2,000 b/d.

PETRÓLEO BRASILEIRO (PETROBRAS). Cubatão, Sao Paulo, Brazil. Plant manager, Irto Sardenberg.
Crude capacity: 94,500 b/sd. Thermal cracking, 9,000 b/sd. Thermal reforming, 11,000 b/sd. Houdriforming, 11,000 b/sd. Polymerization, 1,800 b/sd. Treating, Edeleanu and Tannin Solutizer. Other products: fertilizers and calcium ammonium nitrate.
Construction planned includes ethane cracking and aromatics extraction units, and crude expansion to 115,000 b/d.

PETROLEO BRASILEIRO S.A. (PETROBRAS). Salvador (Mataripe), Bahia, Brazil. Plant manager, Roque Perrone.
Crude capacity: 32,000 b/sd. Vacuum distillation, 10,500 b/sd. Thermal cracking, 2,500 b/sd. Orthoflow catalytic cracking, 12,000 b/sd (fresh feed). Polymerization, 694 b/sd. Treating (phenol extraction, propane dewaxing, propane deasphalting, percolation).

Expansion in crude capacity to 52,000 b/sd will be completed at end of 1960, at estimated cost of $30 million.

PETROBRAS. Duque de Caxias, Caxias, Rio de Janeiro, Brazil.
New 90,000 b/d $60 million refinery, scheduled for completion in 1961. Foster Wheeler has contract.

PETROBRAS plans a $99 million, 25,000 b/d refinery at Santa Lucia, near Belo Horizonte, Brazil.

REFINARIA DE PETRÓLEOS DE MANGUINHOS S.A. Rio de Janeiro, Brazil. Plant manager, Eduardo Difini.
Crude capacity: 10,000 b/d. Thermal cracking, 6,500 b/d. Caustic treating, 10,000 b/d.

REFINERIA E EXPLORACÃO DE PETRÓLEO S.A. Sao Paulo, Brazil. Plant manager, Carlos Eduardo Paes Barresto.
Crude capacity: 31,000 b/d. Vacuum distillation, 8,000 b/d. Thermofor catalytic cracking, 35,000 b/d. Polymerization, 1,000 b/d. Copper sweetening, 17,000 b/d.

Chile

EMPRESA NACIONAL DEL PETROLEO (E.N.A.P.) Concon, Chile. Plant manager, Fernando Reich K.
Crude capacity: 44,000 b/d. Vacuum distillation. Thermal cracking, 10,000 b/sd. Thermal reforming, 4,000 b/sd. Orthoflow Model B catalytic cracking, 12,000 b/sd. SBK catalytic reforming, 6,000 b/sd. Cobalt molybdate catalytic desulfurization, 6,000 b/sd. Kellogg Model B sulfuric acid alkylation, 1,100 b/sd. Naphtha rerunning, 1,200 b/sd. DEA, Caustic, and inhibitor sweetening. Petreco desalting, 24,000 b/sd. Sulfuric acid treating, 15 metric ton/day.

E.N.A.P. Manatiales, Chile.
Crude capacity: 700 b/d.

REFINERIA CHILENA DE PETROLEOS y PETROQUIMICA, S.A. Correo Estacion Maipu, Santiago, Chile. Manager, Arturo Sramek.
Crude capacity: 2500 b/d.

Colombia

COLOMBIAN PETROLEUM CO. Tibu, Colombia. Plant manager, R. E. Alsup.
Crude capacity: 3,300 b/d. Principal products, gasoline, diesel fuel, kerosine.

EMPRESA COLOMBIANA DE PETROLEOS. La Dorada, Colombia.
Crude capacity: 4,000 b/d.

INTERNATIONAL PETROLEUM (COLOMBIA) LTD. Intercol-Barranca refinery, Barrancabermeja, Colombia. Plant manager, F. J. Wellington.
Crude capacity: 36,500 b/cd. Visbreaking, 16,500 b/cd. Fluid Model IV catalytic cracking, 15,130 b/cd. Sulfuric acid alkylation, 1,200 b/cd. Phenol extraction for lubes, 400 b/cd. Caustic treating. Asphalt oxidation, 125 b/cd. Grease, 61 b/cd. Solvents, 1,200 b/cd. Acid plant, 25 ton/day.

INTERNATIONAL PETROLEUM (COLOMBIA) LTD. Intercol-Cartagena refinery, Cartagena, Colombia. Plant manager, P. R. Ratliff.
Crude capacity: 26,500 b/d. Vacuum distillation, 18,000 b/sd. Fluid Model IV catalytic cracking, 13,000 b/d (fresh feed). Polymerization, 3,600 b/sd. Caustic treating. Naphthenic acid manufacture.

THE TEXAS CO. Cuama, Colombia.
Crude capacity: 1,100 b/d.

Ecuador

ANGLO-ECUADORIAN OILFIELDS LTD. Guayaquil, Eucador. Plant manager, B. V. Fenton.
Crude capacity: 13,000 b/d. Vacuum distillation, 300 b/d. Thermal cracking, 6,600 b/d. Caustic treating, 4,000 b/d. Lube oil acid treating and clay treating.
Expansion in crude capacity to 21,000 b/d, at cost of $4.5 million, planned for completion by 1961.

MANABI EXPLORATION CO. INC. Cautiro, Ecuador.
Crude capacity: 500 b/d.

TENNESSEE DEL ECUADOR S.A., Guayaquil, Ecuador. Plant manager, Stanley G. Moss.
Crude capacity, 2,500 b/d. Gas absorption unit, 3 mmcf/d.

(*Continued on page* 109)

MANNESMANN

thrives under pressure

Reactor of Multi-Layer Construction

Recently supplied for a chemical plant in Norway

Outside diameter 2,000 mm (6'7")
Length 19,000 mm (62'2")
Wall thickness 76/35/3 mm (3"/1.3/8"/1/8")
Working pressure 160 atm. (2,275 psi)
Test pressure 208 atm. (3,060 psi)
Weight 110,000 kg (242,500 lbs)
Basic material: Marwe 433 M heat-resistant steel
Cladding layer: chrome-nickel steel grade X 10 Cr Ni Mo Ti 1810

In oil processing and wherever you have thick-walled equipment operating at high pressures, it's almost always sufficient to have merely the surfaces of the containers chemically resistant. No need to use costly acidproof metal grades clear through: one thin layer of cladding is enough • And the answer to that, for cylindrical containers, is multi-layer construction. It gives dependable trouble-free heat transfer through all layers. Furthermore, our heat-resistant metals permit designing to exploit higher yield point values • In multi-layer construction, long service life depends above all on methods and workmanship. Our plants use ultra-modern annealing and stress-relieving furnaces that can turn out units up to 65 ft. long and 16 ft. in outside diameter. With an annular furnace they can even anneal the last circular bead and safely go beyond this length • Continuous, dependable production control of large containers is assured by the very latest processes using ultrasonics, a Betatron, and every other necessary device or procedure • In the design and manufacture of pressure vessels for nuclear power plants, too, we have ample experience. The Mannesmann Research Institute solves problems of flow dynamics with up-to-date testing equipment and novel inspection methods • Please call freely on our engineers for counsel on oil-processing and high-pressure problems – needless to say without cost or obligation.

The Mannesmann product list for the oil industry includes the following items

Seamless and welded tubes for oil processing made from alkali-proof, hydrogen-resistant and heat-resistant steels, as well as alloyed steels; tubes of stainless, acid-resistant and heat-resistant steel, including special alloys and titanium, throughout the entire size range in various surface finishes, e.g. tubes made from stainless steel grades with pickled, ground or electrochemically polished surfaces; Special tubes with increased surfaces, elbows and flanges; complete piping systems of all steel grades; sheet metal, clad plates, collectors, drums and heat exchangers.

MANNESMANN-EXPORT Düsseldorf - Germany

Branch Offices and Representatives all over the world
In USA: American Mannex Corporation,
Canada House, 680 Fifth Avenue, New York 19, N.Y. - Branch Offices: Houston and Los Angeles
In Canada: Canadian Mannex Corporation Limited,
1304 - 4th Street, S.W., Calgary, Alberta - Branch Offices: Toronto, Ontario

LIMITRAK insulation

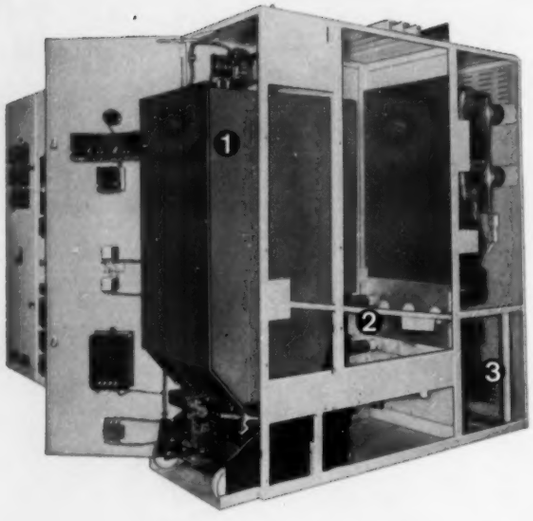
ANOTHER

Westinghouse

FIRST

IN

SWITCHGEAR



(1) Limitrak Glass Polyester, a new Westinghouse-developed insulation, has been tested and proved to be 300 times more track-resistant than ordinary glass polyesters, 1,200 times more track-resistant than phenolics. Westinghouse uses it for arc chutes, end channels and supports on DH breakers; adds **(2) Limitrak Coating** to DH breaker bushings; and, to provide maximum phase-to-phase, phase-to-ground fault protection, incorporates **(3) Limitrak Design** in porcelain insulation components such as vertical bus supports.

This **Limitrak Insulation System** — first to offer truly balanced protection in metal-clad switchgear — is the latest in a series of over 50 major switchgear advances by Westinghouse. Among them:

- *The first power air circuit breaker, installed on a commercial circuit 12 years before any other manufacturer entered the field.*
- *The first drawout air circuit breakers that engage without lifting.*
- *The first complete line of standardized assemblies, each unit fully built, wired and tested at the factory.*
- *Shelterfor-M, the first metal-clad switchgear to give all-weather protection of equipment and personnel at outdoor installations.*

These and the many other Westinghouse "firsts" demonstrate one fact: you get the most advanced, most dependable switchgear by specifying Westinghouse. For more information on Westinghouse metal-clad switchgear, write for booklet O-A. Westinghouse Electric International Co., 40 Wall Street, New York 5, U.S.A.

YOU CAN BE SURE... IF IT'S

Westinghouse

World's Processing Plants

(*Continued from page* 106)

Netherlands Antilles

LAGO OIL & TRANSPORT CO. LTD. Aruba, Netherlands Antilles. General manager, W. A. Murray.
Crude capacity: 470,000 b/sd (440,000 b/cd). Vacuum distillation, 19,200 b/sd. Thermal cracking, 313,000 b/sd. Fluid catalytic cracking, 45,000 b/sd. Sulfuric acid alkylation, 6,700 b/sd. Butane isomerization, 2,400 b/sd. Edeleanu extraction, 44,000 b/sd. Sulfuric acid treating 49,000 b/sd.

SHELL CURACAO N.V. Emmastad, Curacao, Netherland Antilles.
Crude capacity: 210,000 b/d. Thermal cracking, 85,000 b/d. Catalytic cracking, 35,000 b/d. Thermal reforming, 20,000 b/d. Alkylation, 4,500 b/d. Solvent refining (lubes), 6,600 b/d.

Paraguay

COMPAGNIE FIVES-LILLE has indicated plans for a 10,000 b/d refinery at Asuncion, Paraguay.

Peru

CIA DE PETROLEO GANSO AZUL LTDA. Pucallpa, Peru. Plant manager, J. Carranza B.
Crude capacity: 1,100 b/sd.

CIA PETROLERA LOBITOS has applied for approval to build a refinery and lube oil plant at Callao, Peru.

EMPRESA PETROLERA FISCAL (E.P.F.) Iquitas, Peru.
Crude capacity: 1,500 b/d.

INTERNATIONAL PETROLEUM CO. Talara, Peru. Manager, C. Nielsen.
Crude capacity: 45,000 b/d. Thermal cracking, 14,500 b/d. Lubes, 500 b/d.
An expansion in crude capacity has been reported in the planning stages.

MOBIL OIL CO. OF PERU has applied for approval to construct a refinery and lube oil plant at Callao, Peru.

Trinidad

SHELL TRINIDAD LTD. Point Fortin, Trinidad. Refinery manager, M. I. Smith.
Crude capacity, 52,000 b/d. Asphalt, 6,000 b/d. Caustic treating (gasoline, 12,000 b/d), (kerosine, 8,000 b/d). Naphthenic acid production, 10 ton/day.
Expansion in capacity to 64,000 b/d is scheduled for completion by end 1960.

THE TEXAS CO. La Brea, Trinidad.
Crude capacity: 5,000 b/d.

TEXACO TRINIDAD INC. Pointe-a-Pierre, Trinidad, West Indies. Plant manager, H. W. Macnaughton-Jones.
Crude capacity: 135,000 b/d. Vacuum distillation, 60,000 b/d. Visbreaking, 25,000 b/d. Fluid catalytic cracking, 28,000 b/d. Platforming, 8,500 b/d. Unifining, 8,500 b/d. Polymerization, 1,300 b/d (feed). Sulfuric acid alkylation, 2,200 b/d. Vapor phase isomerization, 2,000 b/d.
An $18 million expansion program, due for completion in October, will add 100,000 b/d crude capacity, a 15,000 b/d catalytic reformer and a 20,000 b/d hydrotreater.

Uruguay

ADMINISTRATION NACIONAL DE COMBUSTIBLES, ALCOHOL Y PORTLAND (A.N.C.A.P.). Montevideo, Uruguay.
Crude capacity: 42,000 b/d. Thermal cracking, 2,200 b/d. Catalytic cracking, 1,500 b/d. Catalytic reforming, 3,000 b/d.
Expansion of crude capacity to 56,000 b/d and catalytic cracking to 5,000 b/d is scheduled for 1961.

Venezuela

CIA SHELL DE VENEZUELA. Cardón refinery, Punto Fijo, Venezuela. Plant manager, I. A. Willmott.
Crude capacity: 235,000 b/sd. Vacuum distillation, 89,000 b/sd. Thermal cracking 28,000 b/sd. Thermal reforming, 8,700 b/sd. Fluid catalytic cracking, 35,000 b/sd. Polymerization, 2,000 b/sd. HF alkylation, 2,500 b/sd. Propane deasphalting, Furfural extraction, and MEK dewaxing, total 3,000 b/sd. Treating (Doctor, air Solutizer, caustic).

CIA SHELL DE VENEZUELA. San Lorenzo, Venezuela.
Crude capacity: 45,000 b/d.

CREOLE PETROLEUM CORP. Amuay Bay, Venezuela. Refinery manager, H. De N. Wynne.
Crude capacity: 328,000 b/d. Powerforming, 10,200 b/d. Hydrofining, 17,000 b/d. Solvent refining (lubes), 700 b/d.

CREOLE PETROLEUM CORP. Caripito, Venezuela. Superintendent, F. K. Davis.
Crude capacity: 60,000 b/d. Visbreaking, 42,000 b/d.

PETROCHEMICAL INSTITUTE. Moron, Venezuela.
Crude capacity: 3,000 b/d.

PETROLEOS MEXICANOS will provide 50% of the required capital to establish a new $30 million refinery planned for an as yet undisclosed site in Venezuela.

PHILLIPS PETROLEUM CO. San Roque, Venezuela. General manager, F. H. Keck.
Crude capacity, 3,500 b/d. Wax manufacture, 800 metric ton/month.

RICHMOND EXPLORATION CO. Bajo Grande, Venezuela. Plant manager, L. H. Allen.
Crude capacity: 53,000 b/d. Topping, 43,000 b/d. Combination still, 10,000 b/d.

SINCLAIR VENEZUELAN OIL CO. Puerto la Cruz, Venezuela. Superintendent: J. J. Connelly.
Crude capacity: 35,000 b/d. Visbreaking, 12,000 b/d.

SOCONY MOBIL OIL DE VENEZUELA. Puerto Cabello, Venezuela.
Crude capacity: 35,000 b/d. Catalytic reforming, 5,500 b/d.
Expansion of crude capacity to 50,000 b/d at a cost of $28 million is now essentially completed.

TEXAS PETROLEUM CO. Tucupita, Venezuela. Plant manager, W. F. Hoffman.
Crude capacity: 10,000 b/d.

VENEZUELA GULF REFINING CO. Apartado 16, Barcelona, Venezuela. Superintendent, G. H. Keating.
Crude capacity: 125,000 b/sd. Visbreaking, 14,500 b/sd. Polyforming, 12,000 b/sd. Fluid (Orthoflow) cracking, 8,650 b/sd. Copper sweetening, 30,000 b/sd.

Western Europe

Austria

A. G. DER SHELL FLORIDSDORFER MINERALOELFABRIK. Floridsdorf (Vienna), Austria.
Crude capacity: 4,500 b/d. Lube processing, 1,000 b/d.

KLEDERINGER MINERALOEL RAFFINERIE. Kledering (Vienna), Austria.
Crude capacity: 400 b/d.

MOBIL OIL AUSTRIA A.G. Vienna, Austria. Plant manager, F. Kubelka.
Crude capacity: 3,400 b/cd. Vacuum distillation, 1,300 b/cd. Lube oil treating, 140 b/sd. Grease manufacture, 70 b/sd.

OESTERREICHISCHE MINERALOELWERKE (OMW). Lobau (Vienna), Austria. Manager, Dr. Gustav Kreisler.
Crude capacity: 7,200 b/d.
Owned 50-50 by Mobil and Shell, this refinery is leased indefinitely to the government.

OESTERREICHISCHE MINERALOEL VERWALTUNG A.G. (OMVAG). Schwechat (Vienna), Austria. Plant manager, E. Riba.
Crude capacity: 15,300 b/d. Vacuum distillation, 880 b/d. Thermal cracking, 5,300 b/d. Lube production, 400 b/d. Gasoline treating, 4,300 b/d. Asphalt, 3,400 b/d. Solvents, 700 b/d.
Expansion in crude capacity to 47,900 b/d and addition of facilities for asphalt, special gasoline, and more lubes and greases is planned for 1963. Three other plants of the Austrian Mineral Oil Administration—Voesendorf, Korneuburg, and Moosbierbaum—were scheduled for shutdown and dismantling this year.

RICHARD K. van SICKLE. Neudsiedl Zaya, Niederösterreich, Austria. Plant manager, Stephan Marmeler.
Crude capacity: 1,000 b/d. Principal products, motor fuel, diesel fuel, fuel oil.

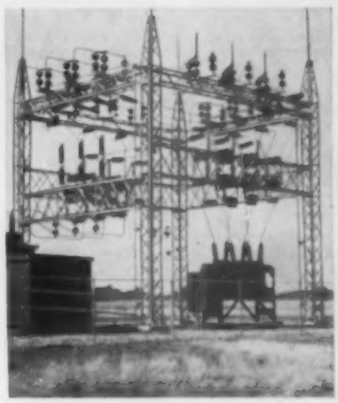
Belgium

"ALBATROS" S.A. BELGE POUR LE RAFFINAGE DE PETROLE. Antwerp, Belgium.
Crude capacity: 12,600 b/d. Catalytic cracking, 4,100 b/d. Catalytic reforming, 2,500 b/d. Polymerization, 600 b/d.

POWER HANDLING NEEDS OF VENEZUELAN OPERATION MET BY

Westinghouse

EQUIPMENT



Power for outdoor pumping rigs of the Mene Grande Oil Company in the San Tome area of Venezuela is handled by this efficient Westinghouse-equipped substation. Dropping the 69 kv input from cross-country transmission lines to 13.8 kv needed for the oil field operations, the installation employs Westinghouse type G circuit breakers, busses, disconnect switches, and metal-clad switchgear. Complete reliability is imperative here because of the continuous nature of petroleum processes, which often allows no more than one annual shutdown for maintenance.

Westinghouse also supplied gas turbines, generators, transformers, relays and controls for Mene Grande. These are only some of the many ways Westinghouse continuously serves petroleum producers and refiners around the world with electrical products of advanced design and superior performance.

BELGIAN SHELL CO. S.A. Ghent, Belgium.
Crude capacity: 2,700 b/d. Solvent refining (lubes), 500 b/d.

ESSO BELGIUM S.A. Antwerp, Belgium. Manager, Mfg., H. P. Relder.
Crude capacity: 36,000 b/d. Model IV Fluid catalyatic cracking, 9,500 b/d. Thermal reforming, 3,700 b/d. Powerforming, 5,000 b/d. Hydrofining, 6,200 b/d.

ESSO BELGIUM S.A. Hoboken-Antwerp, Belgium. Manager.
Crude capacity: 2,300 b/d.

RAFFINERIE BELGE DE PETROLES S.A. Antwerp, Belgium.
Crude capacity: 16,700 b/d. Thermal reforming, 2,700 b/d. Catalytic reforming, 2,300 b/d. Desulfurization, 4,500 b/d.

SOCIETE INDUSTRIELLE BELGE DES PETROLES. Antwerp, Belgium. Plant manager, Gerard Legrand.
Crude capacity: 90,000 b/sd. Vacuum distillation, 20,000 b/sd. Thermal reforming, 7,000 b/sd. Fluid catalytic cracking, 12,500 b/sd. Platforming, 10,000 b/sd. Hydrofining, 10,000 b/sd. Polymerization, 3,000 b/sd. Copper chloride treating, 18,000 b/sd.
Expansion of crude capacity to 180,000 b/d is planned for 1962.

TANKAGE & TRANSPORT S.A. Antwerp, Belgium.
Crude capacity: 4,900 b/d. Catalytic reforming, 700 b/d.

Denmark

A. S. KALUNDBORG. Kalundborg, Denmark. President, A. Tholl.
Crude capacity: 600 b/d.

A. P. MOLLER. Copenhagen, Denmark.
Thermal cracking (oil pyrolisis plant only), 3,300 b/d.

DANSK MINERALOLIEFABRIK. Copenhagen S, Denmark. President, E. Windfeld-Hansen.
Crude capacity: Vacuum distillation 60 b/sd. Sulfuric acid treating. Grease manufacture, 3,000 lb/day.

DANSK VEEDOL (subsidiary of Tidewater Oil Co.) will complete a $24 million, 20,000 b/d refinery at Kalundborg in September, 1961. Contractors are Foster Wheeler Ltd. and Soc. Fives-Penhoet. Process units include: atmospheric and vacuum distillation, catalytic reforming, hydrodesulfurizer, gasoline and kerosine treating.

Finland

NESTE OY. Naantali, Finland. Plant manager, Mikko Tanner.
Crude capacity: 23,000 b/d. Vacuum distillation, 12,000 b/d. Thermofor catalytic cracking, 8,300 b/d (fresh feed). Atlantic Catforming, 3,400 b/d. Polymerization, 1,800 b/d. Caustic treating. Copper sweetening. Asphalt oxidation.

NESTE OY. Turku, Finland.
Crude capacity: 19,200 b/d. Catalytic cracking, 6,000 b/d. Catalytic reforming, 3,400 b/d. Polymerization, 2,000 b/d.

France

ANTAR PETROLES DE L'ATLANTIQUE, Donges, France. Manager: Gaston Reymonenq.
Crude capacity: 50,000 b/d. Vacuum distillation, 1,000 b/d. Thermofor catalytic cracking, 12,000 b/d. Houdry catalytic reforming, 13,000 b/d. Udex, 5,000 b/d.

ANTAR PETROLES DE L'ATLANTIQUE. Merkwiller, France.
Crude capacity: 4,200 b/d. Solvent refining (lubes), 500 b/d.

CALTEX S.A.F. Bec d'Ambes, France.
Crude capacity: 26,000 b/d. Thermal reforming, 4,300 b/d. Catalytic cracking, 4,600 b/d. Polymerization, 400 b/d.

CIE DE RAFFINAGE SHELL BERRE. Berre, France.
Crude capacity: 76,000 b/d. Thermal reforming, 11,800 b/d. Catalytic cracking, 12,800 b/d. Platforming, 14,000 b/d. Visbreaking, 5,300 b/d.
Under construction: Furfural refining unit, 3,500 b/d.

CIE DE RAFFINAGE SHELL BERRE. Pauillac, France.
Crude capacity: 16,000 b/d.

CIE DE RAFFINAGE SHELL BERRE. Petite Couronne, France.
Crude capacity: 90,000 b/d. Thermal cracking, 6,800 b/d. Platforming, 14,000 b/d. Catalytic cracking, 12,800 b/d. Desulfurization, 10,000 b/d. Solvent refining (lubes), 1,800 b/d.

CIE DE RAFFINAGE SHELL BERRE. Strasbourg-Colmar, France. New refinery of 60,000 b/d capacity planned for this location by 1963.

CIE FRANCAISE DE RAFFINAGE. Gonfreville, France. Plant manager, M. J. Chabal.
Crude capacity: 143,000 b/d. Visbreaking, 9,000 b/d. Thermal reforming, 13,000 b/d. Model IV Fluid catalytic cracking, 19,000 b/d. Polymerization, 2,150 b/d.

CIE FRANCAISE DE RAFFINAGE. La Mede, France. Plant manager, M. J. Chieze.
Crude capacity: 130,000 b/d. Thermal cracking, 2,000 b/d. Thermal reforming, 17,000 b/d. Model IV Fluid catalytic cracking, 11,600 b/d. Powerforming, 20,000 b/d. Desulfurization, 12,500 b/d. UOP Hydrogenation, 1,200 b/d. Polymerization, 1,000 b/d.

ESSO STANDARD S.A.F. Bordeaux, France. Manager, J. Creusy.
Crude capacity: 35,000 b/d. Powerforming, 4,800 b/d.

ESSO STANDARD S.A.F. Port Jerome, France. Plant manager, L. Hemmer.
Crude capacity: 80,000 b/d. Thermal cracking, 4,500 b/d. Model IV Fluid catalytic cracking, 20,000 b/d. Powerforming, 11,900 b/d. Hydrofining, 10,800 b/d. Polymerization, 360 b/d. Solvent refining (lubes) 3,200 b/d.

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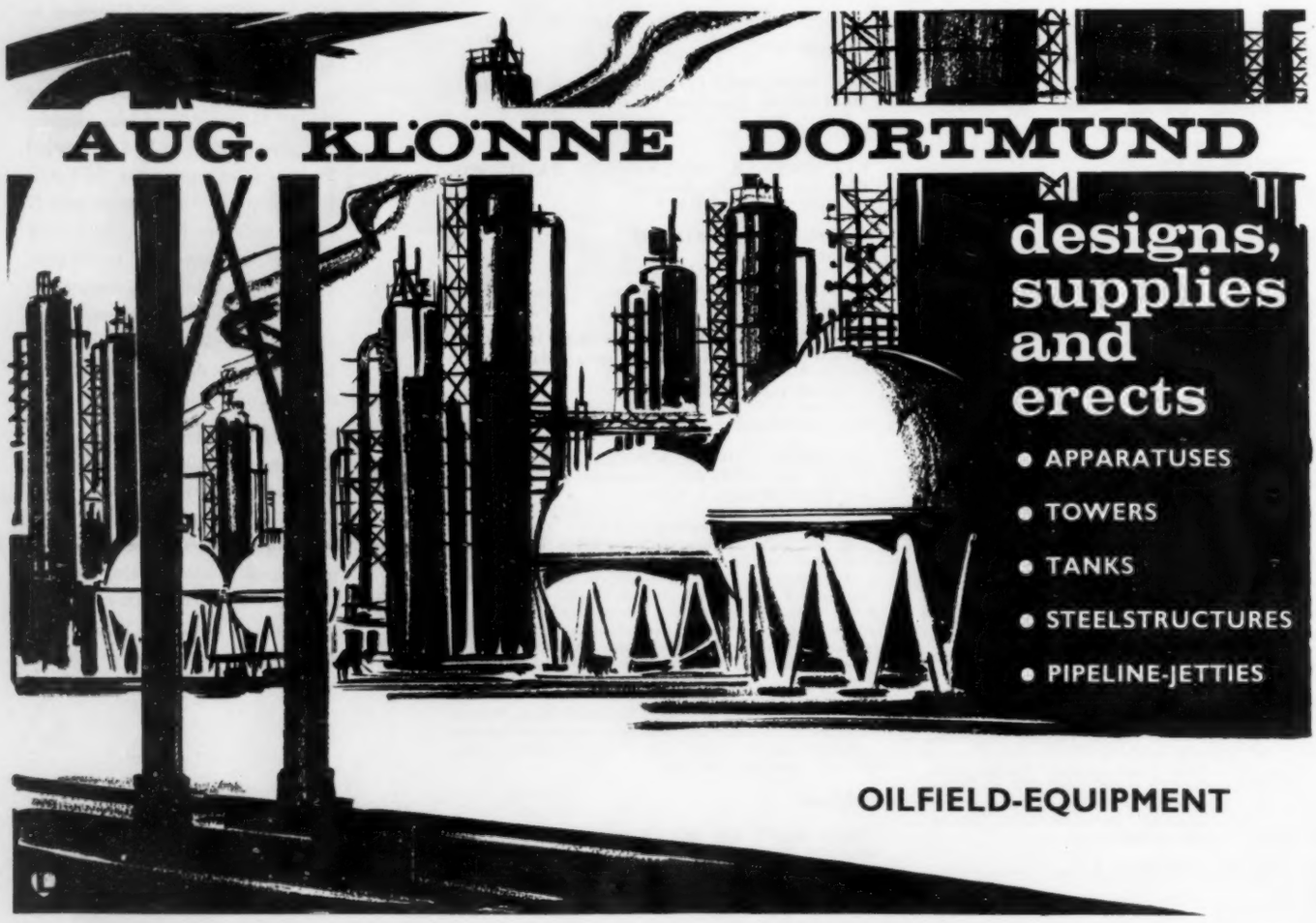

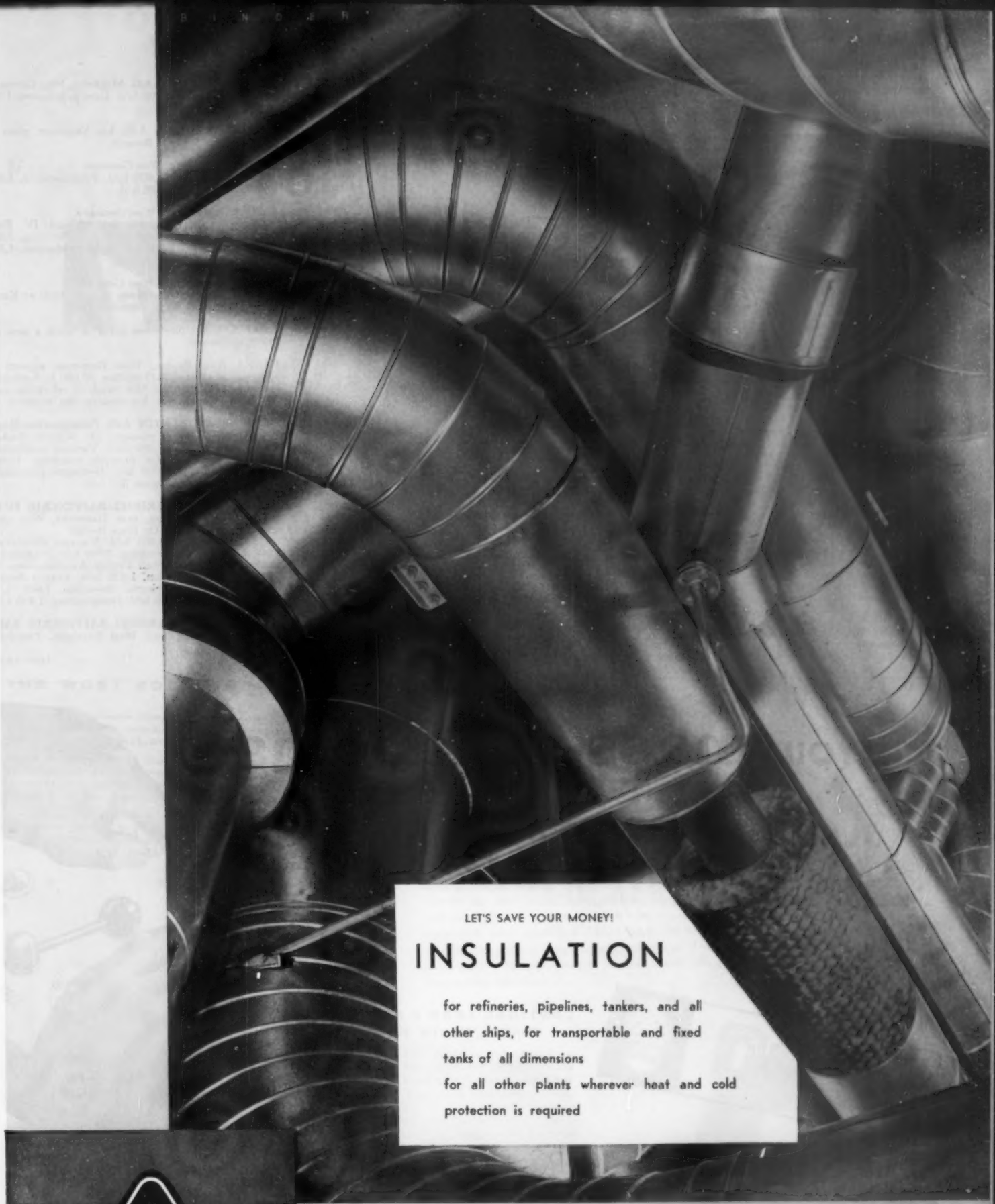

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MOBIL OIL FRANCAISE S.A. Frontignan, France.
Crude capacity: 27,000 b/d. Thermal reforming, 2,200 b/d. Catalytic cracking, 12,700 b/d. Catalytic reforming, 5,000 b/d. Desulfurization, 5,000 b/d.

MOBIL OIL FRANCAISE S.A. Gravenchon, France.
Crude capacity: 22,500 b/d. Thermal reforming, 2,300 b/d. Catalytic reforming, 3,900 b/d. Desulfurization, 5,000 b/d. Solvent refining (lubes) 2,800 b/d. Lube facilities are being expanded.

PECHELBRONN S.A.E.M. Merkwiller-Pechelbronn (Bhas-Rhin), France. Superintendent, Marc Butaud.
Crude capacity: 4,000 b/d. Vacuum distillation. Thermal reforming. Coking. Acid treating.

PETROFRANCE plans a $6 million, 20,000 b/d refinery at Fublaines, France, near the Coulommes field in the Paris basin, pending approval by the government.

SOCIETE FRANCAISE DES PETROLES B.P. Dunkirk, France. Manager, M. Ventajou.
Crude capacity: 44,000 b/d. Thermal reforming, 7,100 b/d. Catalytic reforming, 10,000 b/d. Alkylation, 2,000 b/d. Solvent refining (lubes), 2,000 b/d.

SOCIETE FRANCAISE DES PETROLE B.P. Lavera, France. Managers, M. Delchambre, M. Comade.
Crude capacity: 84,000 b/d. Thermal reforming, 5,400 b/d. Catalytic reforming, 6,100 b/d.

A Group of several French companies—Cie Francaise des Raffinage, Cie. Francaise des Petroles, Pechelbronne S.A.E.M., and Antar Petroles de l'Atlantique—have indicated plans for building a new 60,000 b/d refinery at Strasbourg in 1963.

Germany (West)

RADISCHE ANILIN UND SODAFABRIK A.G. Ludwigshafen/Rhein, West Germany.
This 1,000 b/d refinery has been reported shutdown temporarily. A cracking plant is being constructed.

B. P. BENZIN UND PETROLEUM A.G. Dinslaken, West Germany.
New 90,000 b/d refinery scheduled for completion in 1960. Facilities include vacuum distillation, 17,500 b/d; Fluid catalytic cracking, 10,000 b/d; Platforming, 10,000 b/d; asphalt, 3,000 b/d.

B. P. BENZIN UND PETROLEUM A.G. Hamburg-Finkenwerder, West Germany. Plant manager, Direktor C. Piefke.
Crude capacity: 43,000 b/d. Vacuum distillation, Thermal cracking, 7,600 b/d. Platforming, 6,000 b/sd. Hydrofining (Uhde), 6,500 b/sd. Doctor and Solutizer treating. Asphalt. Sulfur recovery.

B. P. BENZIN UND PETROLEUM A.G. Peine-Hanover, West Germany.
A lube plant of 700 b/d (no crude stills), formerly Oelwerke Julius Schindler GmbH.

B. P. BENZIN UND PETROLEUM A.G. has long-term plans to build a new refinery in Bavaria, West Germany.

DEUTSCHE ERDOEL A.G. Heide/Holstein, West Germany. Plant manager, Dr. Koehler.
Crude capacity: 31,500 b/sd. Vacuum distillation, 8,520 b/sd. Thermofor catalytic cracking, 7,620 b/sd. Platforming-Unifining, 4,000 b/sd. Shell Trickle desulfurization, 8,100 b/sd. Polymerization, 380 b/sd. Solvent refining (lubes), 1,500 b/d.
Expansion in crude capacity to 50,000 b/d is planned for 1963.

DEUTSCHE ERDOEL A.G. Wietz-Celle, West Germany.
Crude capacity: 800 b/d.

DEUTSCHE SHELL A.G. Godorf, West Germany.
Crude capacity: 40,000 b/d. New refinery, scheduled for completion this year, will include catalytic reformer and desulfurizer.
Long range planning indicates this refinery may eventually reach a capacity of 120,000 to 140,000 b/d.

DEUTSCHE SHELL A.G. Hamburg, West Germany.
Crude capacity: 56,000 b/d (represents the combined facilities of the 18,000 b/d Hamburg refinery and the new "Hohe Schaar" 38,000 b/d refinery). Catalytic cracking, 12,000 b/d. Catalytic reforming, 9,000 b/d. Desulfurization, 10,800 b/d. Polymerization, 1,200 b/d. Lube production, 3,200 b/d.

DEUTSCHE SHELL A.G. Manheim, West Germany.
Crude capacity: 6,000 b/d. Lube production, 1,200 b/d.

DEUTSCHE SHELL A.G. has long-term plans to build a new refinery in Bavaria.

ESSO A.G. Cologne, West Germany.
Crude capacity: 68,000 b/d. Powerforming, 6,900 b/d. Hydrofining, 12,300 b/d.

ESSO A.G. Hamburg, West Germany.
Crude capacity: 50,400 b/d. Model IV Fluid catalytic cracking, 10,500 b/d. Powerforming, 7,000 b/d. Hydrofining, 7,600 b/d. Lube production, 1,400 b/d.

ESSO A.G. Karlsruhe, West Germany.
A new 70,000 b/d refinery is to be built at Karlsruhe, with completion expected in 1963.

ESSO A.G. has long-term plans to build a new refinery in Bavaria.

FRISIA A.G. Emden, West Germany, expects to complete this year a $17 million, 30,000 b/d refinery, including a 24,000 b/d SBK catalytic reforming unit. Ralph M. Parsons Co. has construction contract.

GELSENBERG BENZIN A.G. Gelsenkirchen-Horst, West Germany. Plant manager, Dr. Wilhelm Becker.
Crude capacity: 90,000 b/d. Vacuum distillation, 11,500 b/d. Thermofor catalytic cracking, 10,000 b/d. Platforming, 18,000 b/d. Hydrogen processing, 13,300 b/d. Polymerization, 530 b/d.

GEWERKSCHAFT ERDOEL-RAFFINERIE DEURAG-NERAG. Misburg, near Hannover, West Germany. Plant manager, Dr. Hans Weller.
Crude capacity: 11,000 b/d. Vacuum distillation, 9,000 b/d. Thermal cracking, 5,700 b/d. Platformer/Unifiner, 3,000 b/d. Shell Trickle desulfurization, 3,750 b/d. Polymerization, 1,450 b/d. Texaco dewaxing, 1,400 b/d. Edeleanu dewaxing, 1,600 b/d. Furfural refining, 1,850 b/d. Deasphalting, 1,400 b/d.

GEWERKSCHAFT ERDOEL-RAFFINERIE EMSLAND. Lingen-Emsland, West Germany. President, Dr. Josef Rust.

(continued)

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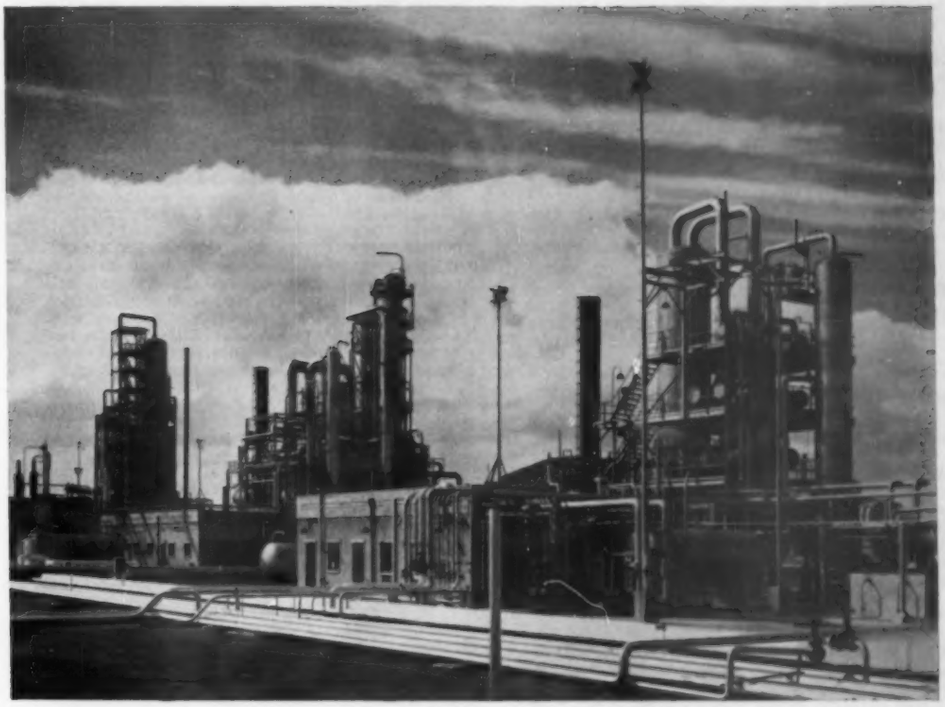

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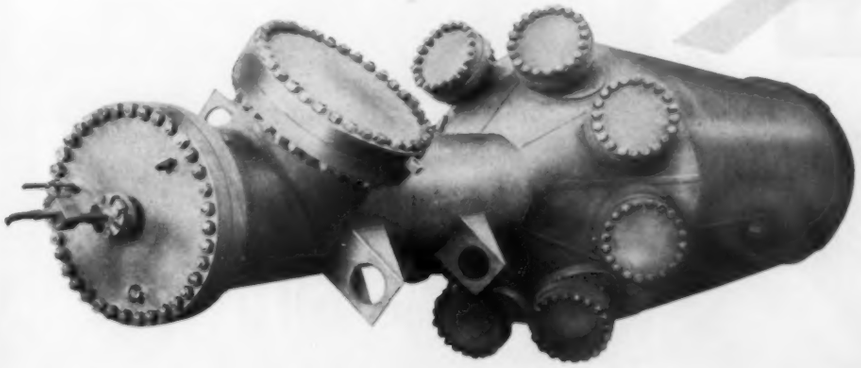

Crude capacity: 55,000 b/d. Catalytic cracking, 8,900 b/d. Catalytic reforming 3,000 b/d. Polymerization, 800 b/d. Hydrodesulfurization.

GEWERKSCHAFT GREIFF BERGBAU MINERALOEL RAFFINERIE. Dollbergen, West Germany.
Crude capacity: 500 b/d.

KRAFTSTOFF HANDELS GmbH. Essen, West Germany.
Crude capacity: 8,000 b/d.

MINERALOEL UND ASPHALTWERKE A.G. Ostermoor-Holstein, West Germany. Manager, Dr. Richard Ladwig.
Crude capacity: 5,000 b/d.

MINERALOELWERKE PEINE. Peine, West Germany.
Crude capacity, 400 b/d.

MOBIL OIL A.G. Bremen, West Germany. Plant manager, H. D. Ruschmann.
Crude capacity: 28,600 b/d. Catalytic cracking, 8,000 b/d. Catalytic reforming, 3,700 b/d. Catalytic desulfurization, 5,000 b/d.

MOBIL OIL A.G., along with Gelsenberg Benzin A.G. and BV-Aral, has indicated long-term plans to build a refinery in Bavaria.

OELWERKE JULIUS SCHINDLER GmbH. Hamburg-Wilhelmsburg, West Germany. Plant manager, Dr. Otto Stuermann.
Crude capacity: 4,200 b/d. Vacuum distillation, 1,100 b/d. Sodium type desulfurization, 450 b/d. Furfural solvent extraction, 1,500 b/d. Sulfuric acid treating, 1,500 b/d. Solvent extraction, 1,900 b/d.
Under construction: 2,350 ton/day, $4.76 million dewaxing unit, to be completed in 1961.

PURFINA MINERALOELRAFFINERIE A.G. Duisburg-Neuenkamp, West Germany. General manager, Dr.-Ing. Herbert J. Kimmerle.
Crude capacity: 20,000 b/d. Platforming and Unifining, 3,600 b/d. HDS-Trickle desulfurization, 3,300 b/d. Copper chloride treating.
Expansion in crude capacity to 60,000 b/d is planned for 1961.

RUHRBAU MINERALOELRAFFINERIE GmbH. Muelheim (Ruhr)-Speldorf, West Germany. General Manager, Dr.-Ing. Herbert J. Kimmerle.
Crude capacity: 6,000 b/d. Vacuum distillation. Principal product, asphalts.

RUHRCHEMIE A.G. Oberhausen-Holten, West Germany. Plant manager, Mr. Knoellinger.
Crude capacity: 9,000 b/d. Thermofor catalytic cracking, 3,000 b/d. Platforming, 2,000 b/d. Unifining, 3,800 b/d.

SCHOLVEN CHEMIE A.G. Gelsenkirchen-Buer, West Germany.
Crude capacity: 40,000 b/d. Catalytic cracking, 4,700 b/d. Catalytic reforming, 9,900 b/d. Hydrogen processing, 8,800 b/d. Polymerization, 200 b/d.
Expansion in crude capacity to 44,000 b/d was planned for 1962.

UNION RHEINISCHE BRAUNKOHLEN KRAFTSTOFF A.G. Wesseling-Cologne, West Germany. Managing directors, Dr. K. Wissel and Dr. W. Wiebourg.
Crude capacity: 65,000 b/sd. Vacuum distillation. Thermal cracking, 12,000 b/sd. Thermal reforming, 6,000 b/sd. Platforming, 6,750 b/sd. Crude oil hydrogenation, 9,500 b/sd. Polymerization, 500 b/sd.

WINTERSHALL A.G. Salzbergen, West Germany. President, Dr. Josef Rust.
Crude capacity: 2,100 b/d. Principal products, lube oils, paraffin, asphalt.

A group composed as follows: Mobil Oil A.G., 25% Wintershall A.G., 15%; Gelsenberg Benzin A.G., 25%; Deutsche Erdoel A.G., 15%; and Scholven Chemie A.G., 20% has declared intention to build a 30,000 refinery at Karlsruhe, West Germany. No official company has been formed. Completion target is 1963.

Greece

"ELBYN" LUBRICATING OIL CO. LTD. Moshaton, Athens, Greece. Plant manager, S. Kotsiopoulos.
Crude capacity (vacuum distillation): 400 b/d. Solvent dewaxing, Furfural extraction, sulfuric acid and clay treating.

Elbyn plans a new 6,000 b/d $3.5 million refinery, pending government approval. Completion would take 18 months. Products planned include 95-100 octane gasoline, fuel oil, LPGas and solvents.

HELLENIC PETROLEUM REFINING CO. Athens, Greece. Superintendent: Carl S. Nelson.
Crude capacity: 40,000 b/d. Vacuum distillation, 2,000 b/d. Atlantic Catforming, 8,000 b/d. Copper treating for kerosine and jet fuels.
An LPG recovery unit is under construction.

OIL TRANSPORTATION, TRADE AND REFINING CO. LTD. Aspropyrgos, Greece.
Crude capacity: 27,000 b/d. Catalytic reforming, 7,400 b/d.

Ireland

IRISH REFINING CO. LTD. Whitegate, Cork, Ireland. Plant manager: Ian McCallum.
Crude capacity: 41,700 b/sd. Powerforming, 9,000 b/sd. Esso hydrodesulfurization (for diesel oil), 6,100 b/sd. Copper sweetening, 3,000 b/sd.

Italy

A.B.C.D. (ASFALTI BITUMI-CATRAMIE DERIVATE). Ragusa, Sicily, Italy.
Crude capacity: 100 b/d.

A.G.I.P. MINERARIA Spa. Cortemaggiore (near Cremona), Italy.
Crude capacity: 6,400 b/d. Catalytic cracking, 3,000 b/d.

A.G.I.P. MINERARIA Spa. Gela, Sicily, Italy.
Crude capacity: 3,300 b/d.

ANIC-GELA, a new ENI company, will build a refining-petrochemical complex at Gela, Sicily, Italy. Anticipated investment in the 60,000 b/d refinery is 49 billion Lira ($78 million). An associated power station to operate on petroleum coke will cost 16 billion Lira ($25 million). Planned product output in addition to coke: LPG, 55,000 ton/yr.; gasoline and light distillates, 8,400 b/d; fuel oil, 9,400 b/d.

ANOMINA PETROLI ITALIANA. Falconara Marittima, near Ancona, Italy. Plant manager, Enrico Calabria.

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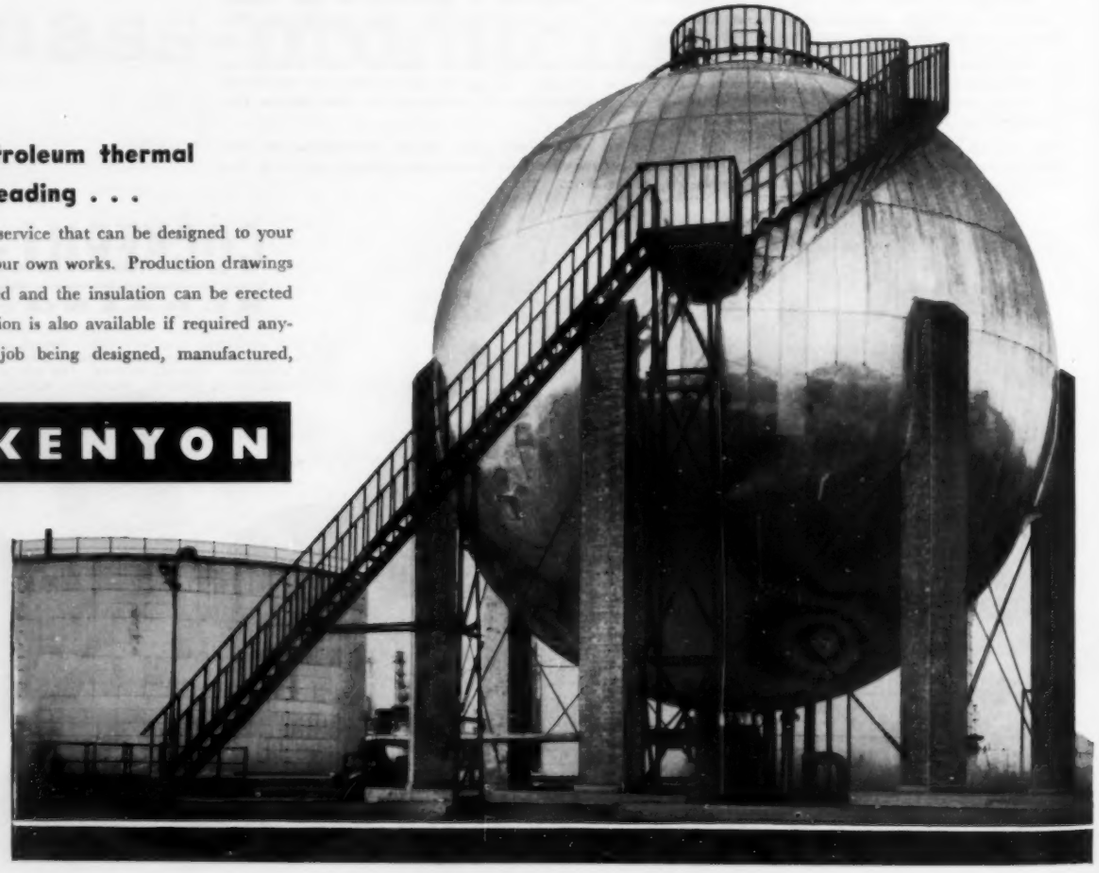

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Under construction, Platformer, 3,000 b/d.

AQUILA (SOCIETA PER AZIONI TECNICO-INDUSTRIALE). Trieste, Italy.
Crude capacity: 31,000 b/d. Thermal reforming, 3,000 b/d. Catalytic cracking, 6,300 b/d. Catalytic reforming, 5,000 b/d. Desulfurization, 5,000 b/d. Polymerization, 1,400 b/d. Lubes, 900 b/d.

CONDOR Spa. PETROLIFERA & CHIMICA (SHELL). Rho, near Milan, Italy.
Crude capacity: 34,000 b/d. Catalytic cracking, 15,000 b/d. Catalytic reforming, 5,100 b/d. Desulfurization, 6,000 b/d.

DELLA PIANE RAFFAELE. Genoa, San Quirico, Italy.
Crude capacity: 1,200 b/d. Catalytic reforming, 400 b/d.

D.I.C.A. (DISTILLERIA ITALIANA CATRAMI). Massa, near Carrara, Italy.
Crude capacity: 2,700 b/d. Thermal cracking, 500 b/d. Catalytic reforming, 400 b/d.

ESSO STANDARD ITALIANA. Trieste, Italy. Plant manager, O. Camus.
Crude capacity: 4,500 b/d. Vacuum distillation, 1,450 b/d. Powerforming, 800 b/d. Treating, 2,270 b/d. Asphalt oxidation, 100 b/d.

EDUARDO GARRONE. Genoa-San Quirico, Italy.
Crude capacity: 35,000 b/d. Powerforming, 5,600 b/d. Hydrofining, 5,000 b/d.

GETTY OIL ITALIANA Spa. Piana de Arzano, Gaeta, Italy. Plant manager, Luigi Togliani.
Crude capacity: 37,500 b/d. Platforming, 3,000 b/d. Unifining.

I.C.I.P. (INDUSTRIE CHIMICHE ITALIANE DEL PETROLIO). Mantua, Italy.
Crude capacity: 21,000 b/d. Thermal cracking, 5,400 b/d. Catalytic reforming, 2,500 b/d.

I.L.S.E.A. (RAFFINERIA OLI MINERALI SpA). Como, Italy.
Crude capacity: 2,800 b/d. Catalytic reforming, 600 b/d.

I.N.P.E.T. (SOCIETA PER L'INDUSTRIA ITALIANA DEL PETROLIO). La Spezia, Italy.
Crude capacity: 40,000 b/d. Thermal reforming, 3,000 b/d. Catalytic reforming, 6,700 b/d.
A 10,000 b/d desulfurization unit is reported planned. Completion date unknown.

I.P.L.O.M. (INDUSTRIA PIEMONTESE LAVORAZIONE OLII MINERALI). Genoa, Italy. Manager: Aldo Pontremoli.
Crude capacity: 10,600 b/d. Catalytic reforming, 1,100 b/d. Desulfurization, 1,000 b/d. Doctor sweetening.
Planned: Vacuum distillation.

I.R.O.M. (INDUSTRIA RAFFINAZIONE OLII MINERALI). Porto Marghera (Venice), Italy.
Crude capacity: 39,000 b/d. Thermal cracking, 700 b/d. Thermal reforming, 7,300 b/d. Catalytic reforming, 2,000 b/d. Desulfurization, 6,500 b/d. Polymerization, 1,600 b/d. Lubes, 300 b/d.

I.S.L.O.M. (INDUSTRIE SICILIANE LAVORAZIONE OLII MINERALI). Palermo, Sicily, Italy.
Crude capacity: 9,000 b/d. Catalytic reforming, 1,400 b/d (planned for completion this year).

"ITALIA" RAFFINERIA DI PETROLIO. Cremona, Italy.
Crude capacity: 26,000 b/d. Thermal cracking, 800 b/d. Thermal reforming, 2,600 b/d. Catalytic reforming, 900 b/d.

LOMBARDA PETROLI S.A. Villasanta (near Monza and Milan), Italy.
Crude capacity: 5,400 b/d. Thermal reforming, 800 b/d.

MARANCO S.A., Mendrisio, Italy.
Capacity: 300 to 400 b/d. Products primarily lubricating oils.

MOBIL OIL ITALIANA. Naples, Italy.
Crude capacity: 85,000 b/d. Thermal reforming, 7,100 b/d. Catalytic cracking, 13,500 b/d. Catalytic reforming, 12,000 b/d. Desulfurization, 10,000 b/d. Polymerization, 900 b/d. Solvent refining (lubes), 2,700 b/d.

MONTECATINI. Ferrara, Italy.
Crude capacity: 4,000 b/d.

RAFFINERIA NILO Spa. Milan, Italy.
Crude capacity: 7,000 b/d. Catalytic reforming, 900 b/d.

PETROLI D'ITALIA SpA. Fiorenzuola (between Parma and Piaceuza), Italy.
Crude capacity: 5,400 b/d. Thermal cracking, 2,000 b/d. Thermal reforming, 800 b/d.

PURFINA ITALIANA. Florence, Italy.
Crude capacity: 4,400 b/d. Thermal reforming, 700 b/d.

PURFINA ITALIANA SpA. Genoa-Bolzaneto, Italy. Plant manager, V. Pessarelli.
Crude capacity: 11,000 b/d. Thermofor catalytic cracking, 1,500 b/d. Platforming, 1,100 b/d. Perco desulfurization, 1,000 b/d. Treating.

PURFINA ITALIANA SpA. Milan, Italy. Plant manager, M. Cesana.
Crude capacity: 7,000 b/d. Vacuum distillation, 3,000 b/d. Perco reforming, 500 b/d. Treating.

PURFINA ITALIANA SpA. Rome, Italy. Plant manager, A. Simonetti.
Crude capacity: 11,000 b/d. Thermofor catalytic cracking, 1,500 b/d. Perco reforming, 500 b/d. Perco desulfurization, 1,000 b/d. Treating.

R.A.S.I.O.M. (RAFFINERIA SICILIANA OLII MINERAL). Augusta, Sicily, Italy. Manager, Aldo Sala.
Crude capacity: 100,000 b/d. Vacuum distillation, 5,000 b/d. Thermal cracking, 10,000 b/d. Thermal reforming, 8,000 b/d. Powerforming, 8,000 b/d. Polymerization, 1,700 bd. Diesel oil desulfurization, 3,500 b/d. Treating.

R.A.S.I.O.M. (RAFFINERIA SICILIANA OLII MINERALI) has been authorized by the Sicilian government to build a 52,000 b/d refinery at Milazzo, near Messina, Sicily, Italy.

R.O.L. (RAFFINERIA OLII LUBRIFICANTI). Vigguzolo, near Alessandria, Italy.
Crude capacity: 1,500 b/d. Solvent refining, 400 b/d.

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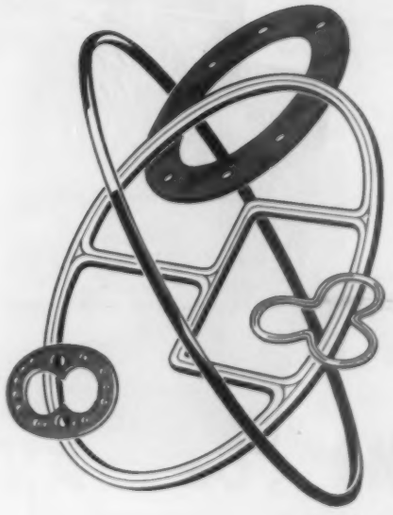

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S.A. MEDITERRANEA RAFFINERIA SICILIANA PETROLI has been authorized by the regional government to build a 50,000 b/d refinery at Milazzo, Sicily, Italy.

SpA. SANQUIRICO. Genoa, San Quirico, Italy. Plant manager, Maurizio Pagliano.
Crude capacity: 4,000 b/d. Perco desulfurization, 1,000 b/d.
Expansion planned: 14,000 b/d topping unit and a 2,000 b/d catalytic reformer.

S.A.R.O.M. (SOCIETA ANONIMA RAFFINAZIONE OLII MINERALI). Ravenna, Italy. General manager, Bruno Riffezer.
Crude capacity: 60,000 b/d. Thermal reforming, 4,500 b/d. Houdriforming, 4,000 b/d. Lurgi desulfurization, 14,000 b/d. Hypochlorite treating, 20,000 b/d. Sulfur, 34 ton/day.

S.A.R.P.O.M. (SOCIETA PER AZIONI RAFFINERIA PADANA OLII MINERALI). Trecate, near Novara, Italy. Manager, J. M. Detweiler.
Crude capacity: 27,000 b/d. Vacuum distillation, 12,000 b/d. Thermal reforming, 3,900 b/d. Catalytic cracking, 5,000 b/d. Polymerization, 1,000 b/d.

S.I.R.O.M. (SOCIETA INDUSTRIA RAFFINERIA OLII MINERALI). Monza, near Milan, Italy.
Crude capacity: 1,300 b/d.

SOCIETA RAFFINERIA DI ROMA. Fregene, near Rome, Italy.
Crude capacity: 26,500 b/d. Catalytic cracking, 2,500 b/d.
This is a plant projected for completion this year, at which time Purfina's 12,000 b/d refinery at Rome is to be dismantled.

S.P.I. (SOCIETA PETROLIFERA ITALIANA). Fornova, near Parma, Italy.
Crude capacity: 2,000 b/d. Catalytic reforming, 900 b/d.

STANIC INDUSTRIA PETROLIFERA. Via Bruno Buozzi, Bari, Italy. Plant manager, Mariano Campos.
Crude capacity: 46,300 b/d. Powerforming, 6,500 b/d. Hydrofining, 6,150 b/d. Treating processes, total 17,700 b/d.

STANIC INDUSTRIA PETROLIFERA. Livorno, Italy. Plant manager, Giovanni Garone.
Crude capacity: 44,600 b/d. Thermal reforming, 3,700 b/d. Fluid hydroforming, 8,000 b/d. Hydrofining, 6,800 b/d. Duo-Sol extraction, 3,000 b/d. Phenol extraction, 2,900 b/d. Treating processes, total 15,500 b/d. Propane dewaxing, 2,150. Clay contacting, 1,750 b/d. Wax production, 11,500 ton/year.

S.T.O.I. Florence, Italy.
Crude capacity: 17,000 b/d. Thermal reforming, 1,000 b/d. Catalytic reforming, 2,500 b/d.

DOTT G. VOLPATO & CO. Milan, Italy. Managing director, Dr. Angelo Volpato.
Crude capacity: 2,100 b/sd. Perco desulfurization, 320 b/sd.

Netherlands

CALTEX PETROLEUM MIJ. Rotterdam, The Netherlands. Plant manager, W. James.
Crude capacity: 59,000 b/sd. Vacuum distillation, 36,000 b/sd. Thermal cracking, 9,000 b/sd. Thermal reforming, 7,500 b/sd. Platformer, 7,500 b/sd. Naphtha Unifiner, 7,500 b/sd. Diesel Unifiner, 4,500 b/sd. Polymerization, 3,000 b/sd (feed). Treating processes, 15,700 b/sd. Sulfur recovery, 12 ton/day.
Expansion to 100,000 b/d is planned for completion in 1961.

ESSO NEDERLAND N.V. Rotterdam, Netherlands.
New $50 million refinery of 95,000 b/d capacity, to be completed late in 1960, will include Powerforming and desulfurization.

SHELL PERNIS RAFFINADERIJ N.V. Pernis, Netherlands.
Crude capacity: 300,000 b/d. Thermal cracking, 20,000 b/d. Thermal reforming, 10,000 b/d. Catalytic cracking, 77,000 b/d. Catalytic reforming, 12,700 b/d. Alkylation, 2,500 b/d. Desulfurization, 21,800 b/d. Polymerization, 4,700 b/d. Lube production, 2,900 b/d.

Norway

A/S NORSKE ESSO. Boks 143, Tonsberg, Norway. Manager, G. Ranke.
Crude capacity: 2,300 b/d. Vacuum distillation, Lube production, 300 b/d.

A/S RAFFINERIET NORGE. Slagen, Norway.
A new 40,000 b/d $31 million refinery, scheduled for completion early in 1961. Bechtel is principal construction contractor.

BRITISH PETROLEUM CO. LTD. Oslo, Norway.
A new refinery, planned for 1961, with crude capacity between 40,000 and 80,000 b/d.

Portugal

S.A.C.O.R. Cabu Ruivo, Lisbon, Portgual.
Crude capacity: 21,600 b/d. Catalytic cracking, 9,500 b/d. Polymerization, 1,300 b/d. Lube production, 200 b/d.
Expansion in crude capacity to 27,000 b/d is planned for next year.

Spain

CIA. ARRENDATORIA DEL MONOPOLIO DE PETROLEOS S.A. Barcelona, Spain. Manager, Joaquin Homs Oller.
Crude capacity: 700 b/d. Vacuum distillation, 700 b/d.

COMPAÑIA ESPAÑOLA DE PETROLEOS S.A. (CEPESA) Santa Cruz de Tenerife, Canary Islands, Spain. Plant manager, A. Preckler.
Crude capacity: 60,000 b/d. Vacuum distillation, 2,500 b/sd. Thermal cracking, 2,500 b/sd. Platforming, 5,000 b/sd. Solvent processes. Doctor sweetening.
Expansion in crude capacity to 72,000 b/d is planned, at a cost of $11 million.

REFINERIA DE PETROLEOS DE ESCOMBRERAS S.A. (REPESA). Escombreras, Spain.
Crude capacity: 80,000 b/d. Thermal reforming, 9,000 b/d. Catalytic reforming, 11,000 b/d. Polymerization, 1,600 b/d. Solvent refining (lubes), 500 b/d.
Expansion in crude capacity to 90,000 b/d is planned for 1961.

Sweden

AXEL JOHNSON & CO. Nynashamn, Sweden.
Crude capacity: 2,400 b/d. Scheduled for expansion to 3,600 b/d. in 1963.

KOPPARTRANS OLJEAKTIEBOLAG. Skarvik, Sweden. General manager, P. Betts.

Crude capacity: 36,300 b/d. Thermal reforming, 4,000 b/d. Catalytic reforming, 5,000 b/d. Desulfurization, 7,200 b/d. Catalytic reformer is being revamped to Platforming.

AB NYNAS-PETROLEUM. Gothenburg, Sweden.
Crude capacity: 3,000 b/sd. Vacuum distillation, 2,300 b/sd.

AB NYNAS-PETROLEUM. Malmo, Sweden.
Crude capacity: 1,900 b/sd. Vacuum distillation, 1,500 b/sd.

AB NYNAS-PETROLEUM. Nynashamn, Sweden.
Crude capacity: 20,000 b/sd. Vacuum distillation, 4,500 b/sd. Thermal reforming, 1,900 b/sd. Platforming, 6,800 b/sd.

SWEDISH SHALE OIL CO. (SVENSKA SKIFFEROLJE AKTIEBOLAGET), Narkes Kvarntorp, Sweden. Plant superintendent: Gosta Salomonsson.
Crude capacity (shale oil, not crude petroleum); 2,000 b/d. Sulfuric acid treating, 2,000 b/d. Products: gasoline, fuel oil, liquefied gases.

Switzerland

ITALO-SUISSE/E.N.I. has indicated plans for building a refinery at Aigle, Switzerland. Possible capacity, 40,000 b/d.

United Kingdom

BERRY WIGGINS & CO. LTD. Kingsnorth-on-Medway, near Rochester, Kent, England. Plant manager, W. J. Grant.
Crude capacity: 3,200 b/d. Vacuum distillation, 2,000 b/d.

BERRY WIGGINS & CO. LTD. Weaste refinery, Eccles New Road, Salford, Lancashire, England. Plant manager, A. E. Tonge.
Crude capacity: 2,200 b/d. Vacuum distillation, 1,700 b/d.

WILLIAM BRIGGS & SONS LTD. Dundee, Scotland, United Kingdom. Refinery manager, Henry A. Watson.
Crude capacity: 1,500 b/d. Vacuum distillation.

B. P. REFINERY (GRANGEMOUTH) LTD. Grangemouth, Scotland, United Kingdom.
Crude capacity: 67,000 b/d. Catalytic cracking, 11,300 b/d. Desulfurization, 500 b/d. Polymerization, 700 b/d.

B. P. REFINERY (KENT) LTD. Isle of Grain, Kent, United Kingdom.
Crude capacity: 180,000 b/d. Thermal reforming, 10,800 b/d. Catalytic cracking, 11,300 b/d. Catalytic reforming, 14,400 b/d. Alkylation, 2,250 b/d. Desulfurization, 18,000 b/d. Solvent refining (lubes), 2,500 b/d.

B. P. REFINERY (LLANDARCY) LTD. Llandarcy, Wales, United Kingdom
Crude capacity: 63,000 b/d. Catalytic cracking, 11,300 b/d. Catalytic reforming, 5,400 b/d. Desulfurization, 3,200 b/d. Solvent refining (lubes), 1,800 b/d.

ESSO PETROLEUM CO. LTD. Fawley, Hampshire, England. Refinery manager, Dr. F. Mayo.
Crude capacity: 230,000 b/d. Vacuum distillation, 69,500 b/d. Thermal cracking, 5,400 b/d. Fluid catalytic cracking, 46,000 b/d. Powerforming, 32,500 b/d. Hydrofining, 26,500 b/d. Polymerization, 4,000 b/d. Propane deasphalting, 4,000 b/d. Propane dewaxing, 2,300 b/d. Phenol treating, 8,500 b/d. Edeleanu plant, 15,000 b/d. Sweetening, total 87,500 b/d. Sulfur recovery, 20,000 long ton/year.

ESSO PETROLEUM CO. LTD. Milford Haven, Wales, England. Refinery manager, E. Asquith.
Crude capacity: 95,000 b/d. Powerforming, 16,500 b/d. Hydrofining, 16,500 b/d. Copper sweetening, 21,000 b/d.
New refinery, scheduled for full operation by end of this year.

LOBITOS OILFIELDS LTD., Ellesmere Port, Cheshire, England. Plant manager, A. Cluer.
Crude capacity: 2,500 b/d. Vacuum distillation. Thermal cracking, 1,300 b/d. Platformer, 800 b/d. Solvent processes, 1,150 b/d. Treating, 500 b/d. Sulfonation unit, 150 b/d. Wax, 50 b/d.

MANCHESTER OIL REFINERY LTD. Trafford Park, Manchester, 17, England. General manager, J. C. Wood-Mallock.
Crude capacity: 3,500 b/d. Solvent refining (lubes), 2,000 b/d. Sulfonates, technical and medicinal white oil, 300 b/d.

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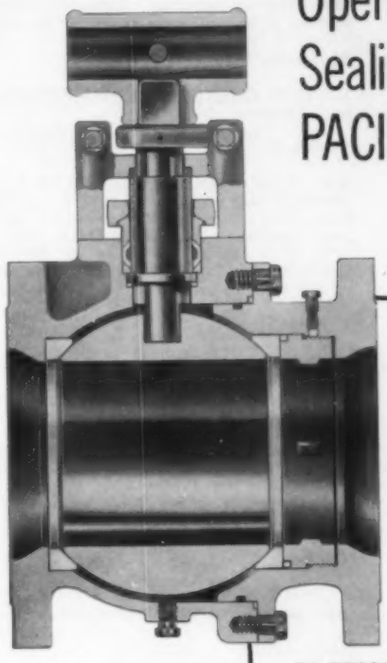

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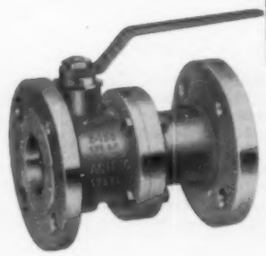

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MOBIL OIL CO. LTD. Coryton, near Stanford-le-Hope, Essex, England. Refinery manager, J. W. Bartholomew.

Crude capacity: 42,000 b/sd. Vacuum distillation, 21,000 b/sd. Thermofor catalytic cracking, 10,500 b/d. Platinum type catalytic reforming, 4,500 b/sd. Propane deasphalting, 7,200 b/sd. Furfural treating, 7,600 b/sd. MEK dewaxing, 3,600 b/sd. Treating processes, 14,000 b/sd. Thermofor continuous percolation, 2,800 b/sd.

SCOTTISH OILS LTD. Pumpherston, Scotland, United Kingdom. Plant manager, F. M. Cook.

Crude capacity: 3,200 b/d. Thermal cracking, 1,400 b/d. Coking, 5,000 long ton/yr. Wax extraction and refining, 12,000 long ton/yr.

SHELL REFINING CO. LTD. Shellhaven, Essex, United Kingdom.

Crude capacity: 160,000 b/d. Thermal reforming, 13,000 b/d. Catalytic reforming, 6,700 b/d. Hydrodesulfurization, 16,000 b/d. Solvent refining (lubes), 2,400 b/d. Asphalt blowing, 300-600 ton/day.

SHELL REFINING CO. LTD. Stanlow, Cheshire, United Kingdom.

Crude capacity: 105,000 b/d. Thermal reforming, 13,000 b/d. Catalytic cracking, 35,000 b/d. Catalytic reforming, 10,000 b/d. Desulfurization, 4,400 b/d. Polymerization, 2,000 b/d. Solvent refining (lubes), 3,900 b/d.

SHELL REFINING CO. LTD. Heysham, Lancashire, United Kingdom.

Crude capacity: 36,000 b/d. Thermal reforming, 4,000 b/d. Visbreaking, 6,000 b/d.

STARHAVEN REFINERIES LTD. Ardrossan, Scotland, United Kingdom.

Crude capacity: 3,200 b/d.

Africa

Algeria

SOCIETE DE LA RAFFINERIE D'ALGER. Algiers, Algeria, plans a new 44,000 b/d refinery, with completion in 1962. This is a seven company group composed as follows: Jersey Standard, 16.2%; Soc. Shell d'Algerie, 21%; Mobil Oil Francaise, 6%; Soc. Francaise des Petroles B. P., 12%; Cie Francaise des Petroles, 23.8%; Cie Francaise de Raffinage, 14%; and Beryl Algerie, 7%.

Angola

COMPANHIA DE PETROLEOS DE ANGOLA (PURFINA). Luanda, Angola.

Crude capacity: 3,000 b/d.

Egypt

ANGLO-EGYPTIAN OILFIELDS LTD. A.E.O. refinery, Suez, Egypt (U.A.R.). Plant manager, Mahmoud El Hifnawi.

Crude capacity: 55,000 b/d. Vacuum distillation, 7,700 b/d. Thermal cracking, 2,800 b/d. Thermal reforming, 2,800 b/d. Solutizer gasoline treating, 5,600 b/d. Acid treating (kerosine), 7,400 b/d.

Expansion by 20,000 b/d in crude capacity is scheduled for completion by 1963 including a 2,300 b/d catalytic reformer.

RAFFINERIE DE PETROLE DU GOVERNMENT. Suez, Egypt (UAR).

Crude capacity: 26,000 b/d. Thermal cracking, 3,600 b/d. Thermal reforming, 3,600 b/d (This is a combination unit which can operate as a thermal cracker or a thermal reformer). Desulfurization, 4,800 b/d. Polymerization, 500 b/d. Lubes, 1,200 b/d.

A 3,000 b/d, $2.7 million catalytic reforming unit and a 2,700 b/d hydrodesulfurizer are planned for 1962-1963 completion.

SOCIETE EGYPTIENNE pour le RAFFINAGE et le COMMERCE du PETROLE (SERCOP), Alexandria, Egypt. Plant manager, O. H. Hafez.

Crude capacity: 4,000 b/d. Catalytic reforming, 800 b/d. Perco desulfurization, 800 b/d. Petreco treating, 1,700 b/d.

Expansion of crude capacity to 26,000 b/d is planned.

Ethiopia

THE RUSSIANS plan to build the first refinery in Ethiopia, at the port of Assab in Eritrea. Capacity of the plant was not disclosed.

Kenya

A GROUP composed of Shell Co. of East Africa and BP (East Africa) Ltd. will build a 36,000 b/d refinery at Mombasa, Kenya, with completion expected in 1963, at an estimated $45 million.

Libya

ESSO SIRTE, a Libya subsidiary of Standard Oil Co. (N. J.) will build a new 4,000 b/d refinery at the Mediterranean terminus, Marsa el Braika, of the pipeline to be built from Esso's Zelten field.

Morocco

SOCIETE CHERIFIENNE DES PETROLES. Petitjean, Morocco.

Crude capacity: 2,400 b/d. Catalytic cracking, 3,500 b/d.

SOC. MAROCAINE ITALIENNE DE RAFFINAGE (SAMIR) will complete in 1962 a new 25,000 b/d, $14 million refinery at Mohammadia, a port 19 miles from Casablanca, Morocco. SAMIR (50% ENI and 50% Moroccan capital), has let the contract to SNAM-Progetti, an ENI affiliate. Plant will include a 4,600 b/d Platformer and a 4,600 b/d Unifiner.

Mozambique

SOCIEDADE NACIONAL DE REFINACÃO DE PETROLÉOS (SONAREP), S.A.R.I. President, Manuel de Queiros Paraina; Edificio Santos Gil, 32 andar Salas 13 a 16, Lourenzo Marques, Mozambique.

SONAREP is building a new 13,000 b/sd refinery at Matola—Lourenzo Marques, Mozambique. Principal products will be gasoline, kerosene, jet fuel, gas oils, and fuel oils. Process units will include a 2,500 b/sd Platformer, 2,500 b/sd Unifiner, and 1,500 b/sd UOP Merox treating unit.

Nigeria

A GROUP of Shell and British Petroleum has indicated plans for a possible new refinery in Nigeria.

South Africa

S. A. COAL, OIL AND GAS CORP. LTD. Sasolburg, South Africa. Managing director: P. E. Rousseau.

Principal products of this coal gasification plant include: gasoline, 2,300 b/d; diesel and furnace oil, 300 b/d; kerosine, heavy fuel oil, wax, LPG.

SOUTH AFRICAN PETROLEUM REFINERIES (PTY) LTD., 106 Victoria Embankment, Durban, So. Africa, general manager, W. J. Stok, has been formed by Royal Dutch/Shell and BP as equal partners, to complete by 1963, a new $70 million, 60,000 b/d refinery at Reunion Rocks, near Durban airport.

SOUTH AFRICAN TORBANITE MINING AND REFINING CO. LTD. Boksburg North, South Africa. Plant manager, G. G. Robertson.

Crude capacity: 3,500 b/d. Vacuum distillation, 2,000 b/d. Thermal cracking, 1,100 b/d. Mercaptan extraction, 2,000 b/d. Acid, caustic, doctor sweetening, totals 1,000 b/d.

STANDARD VACUUM REFINING CO. Durban, South Africa.

Crude capacity: 24,000 b/d. Thermal reforming, 2,000 b/d. Model IV Fluid catalytic cracking, 10,000 b/d. Catalytic reforming, 5,000 b/d. Hydrofining, 6,000 b/d. Polymerization, 300 b/d.

Expansion in crude capacity to 26,000 b/d is planned for 1962.

Sudan

AGIP MINERARIA (a subsidiary of the Italian State-owned ENI) has been negotiating with the Sudanese government on the construction of an $8.5 million refinery at Port Sudan.

A GROUP composed of Royal/Dutch Shell and British Petroleum has proposed to the government of Sudan a refinery of undisclosed size to be constructed at Port Sudan to meet local product requirements.

Tunisia

A NUMBER OF GROUPS, including Shell Oil, the Italian state company E.N.I. and others, have reported plans for refinery installations in Tunisia.

ENTE NATIONALE IDROCARBURI (ENI), the Italian State petroleum company, will build a $22 million, 15,000 b/d refinery at La Skhira, Tunisia.

Middle East

Aden

BP REFINERY (ADEN) LTD., P. O. Box 3003, Aden, Aden Colony. General manager, G. A. Malone.

Crude capacity: 120,000 b/sd. Catalytic reforming: Platformer, 12,000 b/sd. Hydrogen process: Autofining, 3,500 b/sd. SO_2 extraction, 9,000 b/sd. Solutizer, 24,000 b/sd. Copper chloride treating, 32,000 b/sd.

Bahrain

BAHRAIN PETROLEUM CO. Bahrain Island, Bahrain. General manager, L. D. Josephson.

Crude capacity: 186,500 b/d. Vacuum distillation, 34,020 b/d. Thermal cracking, 8,010 b/d. Thermal reforming, 19,950 b/d. Fluid catalytic cracking, 27,300 b/d. Platforming, 10,450 b/d. Naphtha Unifining, 10,450 b/d. Polymerization, 2,050 b/d. SO_2 solvent extraction, 9,310 b/d. Acid treating, 15,130 b/d. Sweetening, 90,000 b/d. Asphalt, 1,990 b/d.

Iran

IRANIAN OIL REFINING CO. Abadan, Iran. General manager, J. P. Jochem.

Crude capacity: 415,000 b/d. Vacuum distillation, 74,000 b/d. Thermal reforming, 81,000 b/d. Fluid catalytic cracking, 35,000 b/d. Alkylation, 10,000 b/d. Butane isomerization, 15,000 b/d. SO_2 extraction, kerosine, 44,000 b/d. SO_2 extraction, aviation aromatics, 20,000 b/d. Furfural extraction, 1,000 b/d. M.E.K., 830 b/d. Treating (caustic, bleach, sulfuric acid, and plumbite units), total 532,000 b/d. Asphalt, 5,000 b/d.

Under construction: a $9.8 million, 20,000 b/d catalytic reformer. Completion target 1962.

IRANIAN OIL EXPLORATION AND PRODUCING CO. Field distillation units, Iran.

Crude capacity: 600 b/d.

IRANIAN OIL EXPLORATION AND PRODUCING CO. Masjid-I-Sulaiman, Iran.

Crude capacity: 18,000 b/d.

NATIONAL IRANIAN OIL CO. Kermanshah, Iran.

Crude capacity: 4,000 b/d.

Expansion in crude capacity to 10,000 b/d was in plans for 1960.

Iraq

GOVERNMENT OIL REFINERIES ADMINISTRATION. Baghdad (Dourah), Iraq.

Crude capacity: 35,100 b/d. Thermal cracking, 4,200 b/d. Thermal reforming, 2,900 b/d. Visbreaking, 9,600 b/d. Catalytic reforming, 1,500 b/d. Solvent refining (lubes), 500 b/d.

Expansion in crude capacity to 43,000 b/d and installation of 5,000 b/d Powerformer and 5,000 b/d kerosine treater now underway, at cost of $11 million. Foster Wheeler is principal engineering and construction contractor.

GOVERNMENT OIL REFINERIES ADMINISTRATION. Qaiyarah, Iraq.

Crude capacity: 5,600 b/d.

Expansion to 7,500 b/d crude capacity is planned for 1961 or 1962.

IRAQ PETROLEUM CO. Haditha, Iraq.

Crude capacity: 6,500 b/d.

IRAQ PETROLEUM CO. Kirkuk, Iraq. General manager, A. J. Perks.

Crude capacity: 2,000 b/d (products used internally). Company also operates a part of its crude stabilization units as a crude topping facility, up to 25,500 b/d maximum capacity.

KHANAQIN OIL CO. Alwand, Iraq.

Crude capacity: 9,000 b/d.

KHANAQIN OIL CO. Basrah (Muftiyah), Iraq.

Crude capacity: 3,900 b/d.

Israel

CONSOLIDATED REFINERIES LTD. Haifa, Israel. Managing director, A. Bartel.

Crude capacity: 75,000 b/d. Vacuum distillation, 4,100 b/d. Thermal cracking, 8,200 b/d. Thermal reforming, 7,500 b/d. Treating (Caustic, acid, plumbite), 8,000 b/d.

Jordan

JORDANIAN REFINERY WORKS CO. Amman, Jordan.

A new 6,600 b/d refinery was scheduled for completion in 1961.

Kuwait

KUWAIT OIL CO. LTD. Mina-al-Ahmadi, Kuwait.

Crude capacity: 171,000 b/d. Catalytic reforming. 3,800 b/d.

Lebanon

IRAQ PETROLEUM CO. Tripoli, Lebanon.
Crude capacity: 11,200 b/d. Catalytic reforming, 3,100 b/d.

MEDITERRANEAN REFINING CO. Sidon, Lebanon. General manager, J. B. Brown.
Crude capacity: 12,500 b/d. Platforming, 1,200 b/d. Treating, 1,600 b/d.

Neutral Zone

AMERICAN INDEPENDENT OIL CO. Mina Abdullah, Kuwait (Neutral Zone). General manager, G. Witherspoon.
Crude capacity: 30,000 b/d.

GETTY OIL CO. Mina Saud, Kuwait, Neutral Zone. Superintendent, J. C. McNair.
Crude capacity: 50,000 b/d.

Qatar

QATAR PETROLEUM CO. Umm Said, Qatar. Manager, G. Tod.
Crude capacity: 600 b/d.
Plans for expanding crude capacity to 2,400 b/d are scheduled for review in 1961.

Saudi Arabia

ARABIAN AMERICAN OIL CO. Ras Tanura, Saudi Arabia.
Crude capacity: 189,000 b/d. Thermal reforming, 25,000 b/d. Catalytic reforming, 14,000 b/d. Alkylation, 1,200 b/d. Hydrofining, 15,000 b/d. Polymerization, 1,000 b/d.
Under construction: asphalt plant.

SAUDI ARABIAN REFINERY CO. (SARCO), established by Amir Sa'd ibn Sa'ud, son of the King, has been granted a concession to build a 20,000 b/d refinery at Jiddah, Saudi Arabia. Contractor is Ralph M. Parsons Co.

Syria

GOVERNMENT, Homs, Syria (U.A.R.)
Crude capacity: 20,000 b/d.

Turkey

ANADOLU TASFIYEHANESI A. S. Mersin, Turkey, plans a $43 million, 61,700 b/d refinery with expected completion in 1962. Plant will include: catalytic reforming, 7,200 b/d; kerosine desulfurization, 7,300 b/d; naphtha hydrodesulfurization, 16,000 b/d. Ownership is as follows: Mobil Refining, S. A., 37%; Cal-Tex, 34%; Raffinaderij Shell Mersin, N. V., 18% and BP, 11%. Foster Wheeler is the contractor.

ISTANBUL PETROL RAFINERISI A. S. will own and operate a 20,800 b/d, $26.65 million refinery at Izmit, to be built by Caltex and a government company, Turkiye Petroleri A. O. Facilities will include Fluid catalytic cracking, Platforming, Unifining, and distillate hydrotreating. M. W. Kellogg Co. is prime contractor.

MARMARA PETROL RAFINERI ISLERI A. S., Istanbul, Turkey, has plans to build a 14,400 b/d refinery near Istanbul.

TURKISH AMERICAN OIL CO., Istanbul, Turkey, has plans to build a 15,000 b/d refinery near Istanbul, to include visbreaking, 2,200 b/d; catalytic cracking, 4,400 b/d; and polymerization, 400 b/d.

TURKISH PETROLEUM CORP. Batman, Turkey. Plant manager, Hasan Goker.
Crude capacity: 7,000 b/sd. Vacuum distillation, 2,000 b/sd. Thermofor catalytic cracking, 3,000 b/sd. Doctor treating, 3,000 b/sd.
Expansion in crude capacity to 13,000 b/d is being planned.

Asia and Far East

Australia

AUSTRALIAN OIL REFINING PTY. LTD. Kurnell, New South Wales, Australia.
Crude capacity: 46,000 b/d. Model IV Fluid catalytic cracking, 24,500 b/d. Polymerization, 2,700 b/d. Propane decarbonizer, 9,500 b/d.
Expansion in crude capacity to 60,000 b/d is planned for 1961.

BITUMEN AND OIL REFINERIES (AUSTRALIA) LTD. (BORAL). Brisbane, Queensland, Australia.
Crude capacity: 2,000 b/d.

BITUMEN AND OIL REFINERIES (AUSTRALIA) LTD. (BORAL). P. O. Box 1, Matraville, N.S.W. Australia. Plant manager, B. A. Raper.
Crude capacity: 17,000 b/d. Vacuum distillation, 10,000 b/sd. Catalytic reforming; Platformer, 5,500 b/sd. Naphtha Unifining, 5,400 b/sd. Diesel oil Unifining, 4,500 b/sd. Solvents fractionation, 800 b/sd. Two asphalt converters of 500 bbl holding capacity.
BORAL expects to complete a new $5 million Fluid catalytic cracking unit at Matraville by the end of 1961.

B. P. REFINERY AUSTRALIA LTD. Kwinana, Western Australia.
Crude capacity: 70,000 b/d. Catalytic cracking, 12,500 b/d. Platforming 10,000 b/d. Desulfurization, 5,600 b/d.
Under construction: £8.5 million lube oil plant, with completion expected in 1963.

SHELL REFINING (AUSTRALIA) PTY. LTD. Clyde refinery, P. O. Box 26, Granville, N.S.W., Australia. Plant manager, T. A. Dent.
Crude capacity: 20,000 b/d. Vacuum distillation, 1,300 b/d. Catalytic reforming, Platformer, 6,700 b/d. Lube treating and solvents manufacture.
A $50 million expansion program at Clyde includes a $38 million, 11,750 b/d catalytic cracking unit, to be completed about 1963.

SHELL REFINING (AUSTRALIA) PTY LTD. Geelong refinery, Corio, Victoria, Australia. Plant manager, R. D. Crook.
Crude capacity: 46,000 b/d. Vacuum distillation, 30,400 b/d. Fluid catalytic cracking, 15,000 b/d. Platforming, 6,700 b/d. Shell hydrodesulfurization, 11,000 b/d. Mixed feed polymerization, 1,800 b/d. Solutizer and Diethanolamine treating. Asphalt, 100 metric ton/day. Sulfuric acid manufacture, 100 metric ton/day.

STANDARD-VACUUM REFINING CO. (AUSTRALIA) PTY. LTD. Altona, Victoria, Australia. Refinery manager, R. J. Anderson.
Crude capacity: 43,000 b/d. Airlift Thermofor catalytic cracking, 25,000 b/sd. Platforming, 8,000 b/sd. Catalytic hydrodesulfurization, 10,000 b/sd. Sulfuric acid alkylation, 1,700 b/sd. Asphalt oxidation, 2,000 b/sd.

STANDARD VACUUM REFINING CO. plans a 30,000 b/d, $30 million refinery at Adelaide, South Australia, with completion anticipated in 1962.

British Borneo

SARAWAK SHELL OILFIELDS LTD. Lutong, Miri, Sarawak, British Borneo. Plant manager, A. H. Garside.
Crude capacity: 46,000 b/cd. Principal products, gasoline, naphtha, gas oil, marine diesel fuel, fuel oil.

Burma

BURMAH OIL CO. LTD. Chauk, Burma.
Crude capacity: 4,000 b/d.

BURMAH OIL CO. LTD. Syriam (Rangoon) Burma.
Crude capacity: 3,500 b/d. Thermal cracking.

NATHSINGH OIL CO. LTD. Yenangyaung, Burma. Managing director, V. Nathsingh.
Crude capacity: 500 b/d.

Ceylon

A MULTI-COMPANY GROUP (BP and Shell 60%, Stanvac 20%, Caltex 20%) is planning a 22,000 b/d refinery at Colombo, Ceylon, with expected completion in 1963. Cost is estimated at $30 million.

India

ASSAM OIL CO. LTD. Digboi, India. Manager: Sri A. Subramani.
Crude capacity: 10,000 b/d. Thermal cracking, 1,900 b/d. Lubes, 100 b/d.

BURMAH-SHELL REFINERIES LTD. Bombay, India. Manager, D. W. Wookey.
Crude capacity: 80,000 b/d. Catalytic cracking, 12,000 b/d. Platforming, 6,700 b/d. Lube oils, gasoline and kerosine treating. Asphalt production.
Figures represent capacity at completion of current expansion program.

CALTEX (INDIA) LTD. Visakhapatam, India.
Crude capacity: 16,000 b/d. Model IV catalytic cracking, 7,500 b/d. Polymerization, 800 b/d.

INDIAN REFINERIES LTD. (owned 2/3 by Assam Oil Ltd. and 1/3 by the Indian Government) is reportedly planning a 40,000 b/d refinery at Barauni, Bihar, India, with completion scheduled for 1963. It has been further reported that help may come from British, Italian, Rumanian, or Russian interests.

INDIAN REFINERIES LTD. (see previous item), expects to complete in 1961 a 16,000 b/d $10.5 million refinery at Gauhati, Assam, India, with engineering and construction by Rumanian government interests.

STANDARD-VACUUM REFINING CO. OF INDIA LTD. Bombay, India. Refinery manager, C. W. Couch.
Crude capacity: 38,000 b/d. Vacuum distillation, 2,600 b/d. Thermal reforming, 3,800 b/d. Model IV Fluid catalytic cracking, 8,800 b/d. (total feed). Polymerization, 250 b/d. SO_2 extraction, 4,200 b/d. Copper chloride and Hypochlorite treating, Asphalt, 1,750 b/d.

Indonesia

N. V. DE BATAAFSCHE PETROLEUM MIJ. (SHELL). Balik Papan. Kalimantan, Indonesia. Plant manager, R. F. Clay.
Crude capacity: 75,000 b/d. Vacuum distillation, 12,000 b/d. Solutizer treating, 3,600 b/d. Wax production, 50,000 ton/year.

N. V. DE BATAAFSCHE PETROLEUM MIJ. (SHELL). Pladju, South Sumatra, Indonesia.
Crude capacity: 114,000 b/d. Thermal cracking, 10,000 b/d. Thermal reforming, 15,000 b/d. Alkylation, 5,300 b/d. Polymerization, 400 b/d.

N. V. DE BATAAFSCHE PETROLEUM MIJ. (SHELL). Tjepu, Central Java, Indonesia.
Crude capacity: 4,600 b/d.

N. V. DE BATAAFSCHE PETROLEUM MIJ. (SHELL). Womokromo, East Java, Indonesia.
Crude capacity: 3,200 b/d.

INDONESIAN GOVERNMENT. Pangkalan, Brandan, North Sumatra, Indonesia.
Crude capacity: 2,000 b/d.

STANDARD-VACUUM PETROLEUM MIJ. Sungei Gerong, South Sumatra, Indonesia.
Crude capacity: 75,000 b/d. Thermal cracking, 34,000 b/d. Catalytic cracking, 10,000 b/d. Alkylation, 800 b/d. Polymerization, 1,200 b/d.

Japan

DAIKYO OIL CO. Yokkaichi, East Coast of Honshu, Japan.
Crude capacity: 49,500 b/d. Thermal reforming, 200 b/d. Catalytic cracking, 3,500 b/d. Catalytic reforming, 3,000 b/d. Lubes, 1,800 b/d.

GENERAL BUSSAN. Kawasaki, Tokyo Bay, Japan.
Crude capacity of this new refinery, planned for completion in 1962, will be 35,000 b/d, and it will include a 3,800 b/d catalytic reforming unit, and 5,700 b/d Merox unit.

IDEMITSU KOSAN LTD. Shingu-Cho, Tokuyama City, Yamaguchi Pref., Japan. Plant manager, Masami Ishida.
Crude capacity: 100,000 b/sd. Vacuum distillation, 20,000 b/sd. UOP catalytic cracking, 7,000 b/d. Platforming, 3,000 b/sd. Unisol, 5,000 b/sd. Unifining, 9,000 b/sd. Sulfur recovery. Asphalt.
Under construction: Platforming, 5,000 b/sd; and a UOP Merox unit, 10,000 b/d is planned.

IDEMITSU KOSAN LTD. plans a new 50,000 b/d refinery in 1962, at Kawasaki, on Tokyo Bay, Japan, including a 15,000 b/d catalytic cracking unit, and a 5,000 b/d catalytic reforming unit.

KITA NIPPON OIL CO. Hakodate, Hokkaido, Japan.
Crude capacity: 10,800 b/d. Catalytic reforming, 1,500 b/d.

KOA OIL CO. LTD. 1768, Wagi-Mura, Kuga-Gun, Yamaguchi-Ken, Japan. Plant manager, Hiroshi Kinpara.
Crude capacity: 34,000 b/sd. Vacuum distillation, 12,000 b/sd. Fluid catalytic cracking, 5,500 b/sd. Platforming, 3,300 b/sd. Doctor sweetening, 4,800 b/sd. Acid treating, 1,600 b/sd.
A 5,360 b/sd coking unit is under construction. Unifining and Merox units are planned.

MARUZEN OIL CO. LTD. Matsuyama refinery, Matsuyama, Ehime Pref., Japan. Plant manager: Yasuhiko Wakisaka.
Crude capacity: 25,000 b/d. Visbreaking, 4,500 b/d. Platforming, 3,000 b/d. Treating processes, total 6,000 b/d. Feed preparation unit, 4,000 b/d.
Planned: Unifiner, 4,000 b/d; Udex, 1,500 b/d.

MARUZEN OIL CO. LTD. Osaka refinery, 2-Chome, Hukamchi, Taisho-ku, Osaka, Japan. Plant manager, C. Sakamoto.
The Osaka refinery is a grease plant.

MARUZEN OIL CO. LTD. (Shimotsu refinery), Wakayama, Japan. Plant manager, Y. Tsubota.
Crude capacity: 37,500 b/d. UOP Fluid catalytic cracking, 3,000 b/d. Duo-Sol extraction, 1,000 b/d. MEK dewaxing, 750 b/d. Treating processes, total, 12,000 b/d.
Planned: Unifiner-Platformer, 6,000 b/d; Unifiner, 4,500 b/d.

MARUZEN OIL CO. is scheduled to complete an 18,000 b/d refinery at Goi (Chiba) on Tokyo Bay, Japan, in 1960, with possible expansion to 60,000 to 100,000 b/d in about five years.

MITSUBISHI OIL CO. LTD. Kawasaki refinery, Kawasaki City, Japan. Plant manager, Toshio Kondo.
Crude capacity: 51,620 b/sd. Vacuum distillation, 4,000 b/sd. Platforming, 5,500 b/sd. Unifining, 12,500 b/sd. Furfural refining, 430 b/sd. M.E.K. toluol dewaxing, 600 b/sd. Treating processes, total, 7,950 b/sd. Udex extraction, 750 b/sd. Crude desalting, 25,000 b/sd. Asphalt oxidation, 300 b/sd.

MITSUBISHI OIL CO. plans a 20,000 b/d, $38.5 million refinery at Kurashiki City, Okayama Pref., Japan, with completion of the first phase anticipated for March, 1961.

NEW ASIA OIL CO. Yokohama, Japan. Plant superintendent, Katsumi Koyama.
Crude capacity: 15,000 b/d. Vacuum distillation, 1,000 b/d. Platforming-Unifining, 1,600 b/d. Gasoline treating, 3,000 b/d. Kerosine treating, 1,500 b/d. Lubes, 500 b/d.
Planned for 1961 completion: Unifiner, 3,000 b/d; Platformer-Unifiner, 5,000 b/d; Merox, 4,000 b/d.

NIPPON MINING CO. Funakawa, west coast of Honshu, Japan.
Crude capacity: 19,350 b/d. Catalytic reforming, 1,000 b/d. Lubes, 400 b/d.

NIPPON MINING CO. will install by mid-1961 at its new refinery at Mizushima (between Kobe and Hiroshima), a 6,000 b/d Houdriformer and an 8,000 b/d hydrodesulfurization unit. Planned also: Unifiner, 2,000 b/d; and Unisol, 2,500 b/d.

NIPPON OIL CO. Akita, Japan. Manager: Yasushige Tokuno.
Crude capacity: 3,400 b/d. Thermal cracking, 1,000 b/d. Lube oils, 200 b/d.

NIPPON OIL CO. Kashiwazaki, Japan. Manager: Kazuhiko Ozahi.
Crude capacity: 2,400 b/d. Lube oils, 200 b/d.

NIPPON OIL CO. Niigata, Japan. Manager: Shizno Hirano.
Crude capacity: 5,900 b/d. Catalytic reforming, 1,600 b/d. Lube oils, 900 b/d.

NIPPON PARAFFIN CO. Tokuyama, Inland Sea, Japan.
Crude capacity: 1,900 b/d.

NIPPON PETROLEUM REFINING CO. LTD. 766 Miyanosuhama, Higashitoyoi, Kudamatsu City, Japan. Plant manager, Tamiji Kuwabara.
Crude capacity: 16,500 b/sd. Vacuum distillation, 3,300 b/sd. Platforming, 1,650 b/sd. Furfural extraction, 550 b/sd. Benzol ketone dewaxing, 1,000 b/sd. Treating processes, total 4,800 b/sd. Clay contact, 1,100 b/sd. Asphalt, 570 b/sd. Wax, 120 b/sd.

NIPPON PETROLEUM REFINING CO. LTD. 165 Horomoecho, Muroran City, Japan. Plant manager, Shigeo Iida.
Crude capacity: 7,500 b/sd. Treating, 2,375 b/sd.

NIPPON PETROLEUM REFINING CO. LTD. Yokohama City, Japan. Plant manager, Akira Ogura.
Crude capacity: 45,600 b/sd. Vacuum distillation, 8,000 b/sd. Fluid Model IV catalytic cracking, 5,600 b/sd. Unifining-Platforming, 3,300 b/sd. Propane deasphalting, 3,500 b/sd. Furfural extraction, 1,080 b/sd. Benzol ketone dewaxing, 3,150 b/sd. Treating processes, 10,860 b/sd. Clay contacting, 1,300 b/sd. Asphalt, 200 b/sd. Wax, 110 b/sd.
Planned: for 1961 completion, 7,500 b/d UOP Fluid Catalytic cracking unit.

REKISEI MINERAL OIL CO. Niigata, west coast of Honshu, Japan.
Crude capacity: 1,100 b/d. Lubes, 300 b/d.

SHOWA OIL CO. Hirasawa, west coast of Honshu, Japan.
Crude capacity: 2,700 b/d. Lubes, 400 b/d.

SHOWA OIL CO. Kawasaki, Tokyo Bay, Japan.
Crude capacity: 25,000 b/d. Conventional lube manufacture, 1,000 b/d. Solvent refining, 300 b/d.
Planned: For 1961 completion, 6,000 b/d Unifiner-Platformer. Planned, no completion date, Unifiner and Merox units.

SHOWA OIL CO. Niigata, west coast of Honshu, Japan.
Crude capacity: 9,000 b/d. Lubes, 400 b/d.

SHOWA YOKKAICHI OIL CO. Yokkaichi, east coast of Honshu, Japan.
Crude capacity: 36,900 b/d. Catalytic cracking, 12,000 b/d.

TAIYO OIL CO. Kameoka, Shikoku, Japan.
Crude capacity: 4,500 b/d. Lubes, 400 b/d.

TOA NENRYO KOGYO. Shimizu, east coast of Honshu, Japan.
Crude capacity: 32,000 b/d. Catalytic reforming, 4,600 b/d. Desulfurization, 4,200 b/d. Lubes, 600 b/d.
Under construction: expansion of downstream process units, at cost of $12.5 million.

TOA NENRYO KOGYO. Wakayama, Inland Sea, Japan.
Crude capacity: 43,500 b/d. Thermal cracking, 3,200 b/d. Catalytic cracking, 18,000 b/d. Catalytic reforming, 4,200 b/d. Alkylation, 1,500 b/d. Conventional lube manufacture, 900 b/d, solvent refining, 700 b/d.

TOA OIL CO. Kawasaki, Tokyo Bay, Japan.
Crude capacity: 28,800 b/d.
A new 9,000 b/d catalytic reforming unit is scheduled to begin operations in 1960.

Korea

SOUTH KOREA government has approved building of a 15,000 b/d refinery jointly by local interests, Korean Petroleum, and an unnamed American interest. Korean Petroleum will supply $5 million; the American partner will put up $8 million; and another $2.5 million in local currency will be required. Possible sites include Masan, Mokpop, Yosu, or Ulsen. Expected completion is 1964.

Malaya

SHELL CO. OF THE FEDERATION OF MALAYA LTD. plans a $20 million refinery in Malaya; site as yet is not decided.

STANDARD VACUUM OIL CO. plans a new refinery at an undecided site in Malaya. Total investment of $30 million will include a synthetic fertilizer plant.

New Zealand

SHELL is planning to build a 40,000 b/d refinery at an undisclosed site in New Zealand. Completion data not revealed.

Pakistan

ATTOCK OIL CO. LTD. Rawalpindi, Pakistan.
Crude capacity: 5,000 b/d.

PAKISTAN REFINERY LTD. (Stanvac 18%, Shell 36%, Caltex 6%, private capital 40%) will start construction in October of this year on a new 32,000 b/d $35 million refinery at Korangi, six miles east of Karachi, Pakistan, with completion anticipated in 1962, and ultimate possible expansion to 42,500 b/d planned for in the design.

Philippines

CALTEX (PHILIPPINES). Batangas, Philippine Islands.
Crude capacity: 23,000 b/d. Model IV Fluid catalytic cracking, 5,400 b/d. Polymerization, 1,500 b/d.

FILOIL REFINERY CORP., Union Cement Bldg., Bonifacio Drive, Manila, Philippine Islands, is planning a new 10,000 b/d refinery, with expected completion in 1961 if approved. Proposed site is Rosario, Cavite. Products would include gasoline, kerosine, bunker fuel, diesel fuel, and diesel oil. President of Filoil is Ramon V. del Rosario.

SHELL REFINING (PHILIPPINES) INC. plans a 25,000 b/d refinery at Batangas, 76 miles south of Manila, with completion scheduled in two years. Total capital of 43 million pesos ($21.5 million) involved in project will comprise about 25% local investment and 70% British.

STANDARD-VACUUM REFINING CORP. (PHILLIPPINES), Manila, Philippine Islands. General manager, R. E. Pulver.
Crude capacity: 24,000 b/d. Vacuum distillation, 9,200 b/d. Thermofor catalytic cracking, 6,500 b/d (fresh feed). Catalytic reforming, 3,400 b/d. Hydrodesulfurization, 8,750 b/d str. run naphtha and 5,500 b/d gas oil. Polymerization, 1,800 b/d. Treating, 2,400 b/d. Caustic washing, 2,500 b/d gasolines and 3,000 b/d kerosine.

Singapore

MARUZEN OIL CO., in a joint venture with Tokyo Menka Kaisha Ltd. will complete a 20,000 b/d, $22 million refinery at Singapore in November, 1961.

SHELL OIL CO. OF SINGAPORE LTD. plans a $13 million, 20,000 b/d refinery on Pulau Bukom, 4 miles south of Singapore Island.

Taiwan

CHINESE PETROLEUM CORP. Kaohsiung, Taiwan. Vice President, J. S. Hu.
Crude capacity: 35,000 b/d. Vacuum distillation, 12,000 b/d. Thermal cracking, 4,500 b/d. Thermofor catalytic cracking, 10,000 b/d. Atlantic catalytic reforming, 3,100 b/d. Unifining 5,500 b/d. Sulfuric acid alkylation 900 b/d. Sulfur, 15 ton/day. Sulfuric acid, 15 ton/day.

Thailand

EASTERN PETROLEUM (associated with Indiana Standard) will build a $35 million, 28,000 b/d refinery at an undisclosed site in Thailand.

THAI GOVERNMENT. Farng, Thailand.
Crude capacity: 1,000 b/d.

JAPANESE INTERESTS are planning a 5,000 to 15,000 b/d $20 million refinery in Bangkok, Thailand, with completion expected in 1962 or 1963.

Vietnam

A GROUP including Standard-Vacuum, Shell Vietnam and Caltex have been developing plans for a refinery in central Vietnam, which would be the first of its type to be built in the country.
Another company, Sterling Oil (backed by American Independent, Phillips and others) has reportedly bought land near Saigon for storage facilities and possible new refinery also.

USSR and Satellites

A RUSSIAN designed, 20,000 b/d refinery has gone into operation at Lanchow, China. Capacity is scheduled for increase to 100,000 b/d by the end of 1962, assuming completion of a 400-mile crude line from the Yumen fields to the northwest.

THE HUNGARIAN GOVERNMENT will build a new 60,000 b/d refinery on the Danube River, 15 miles south of Budapest, Hungary. Capacity will be over three times that of all existing plants in the country.

MASCHINO-IMPORT is constructing an $11 million refinery at Ploesti, Romania. The French firm ENSA (Schneider Group) and Italian company, Ansaldo, have signed agreements to supply the plant.

RAFINERIJA NAFTE BOSANSKI BROD (Yugoslav government) Bosanski Brod, Yugoslavia.
Crude capacity: 6,600 b/d Thermal cracking, 2,400 b/d. Lubes, 400 b/d.
Expansion in crude capacity to 13,200 b/d and addition of 2,000 b/d thermal reforming is planned for 1961.

RAFINERIJA NAFTE "BORIS KIDRIC" (Yugoslav government) Rijeka, Yugoslavia.
Crude capacity: 8,500 b/d. Solvent refining, 800 b/d.
Installation of 2,000 b/d catalytic reforming is planned for 1961.

RAFINERIJA NAFTE SISAK (Yugoslav government) Sisak, Yugoslavia. Plant manager, Karlo Krajner.
Crude capacity: 7,200 b/d. Vacuum distillation, 3,600 b/d. Catalytic cracking, 2,000 b/d. Treating.
Planned: expansion to 15,000 b/d in 1963, plus catalytic reforming.

YUGOSLAV GOVERNMENT is planning a new 21,900 b/d refinery for 1962, at a location as yet undecided. It will include: catalytic cracking, 11,000 b/d; catalytic reforming, 3,500 b/d; desulfurization, 6,300 b/d; and lube production, 400 b/d.

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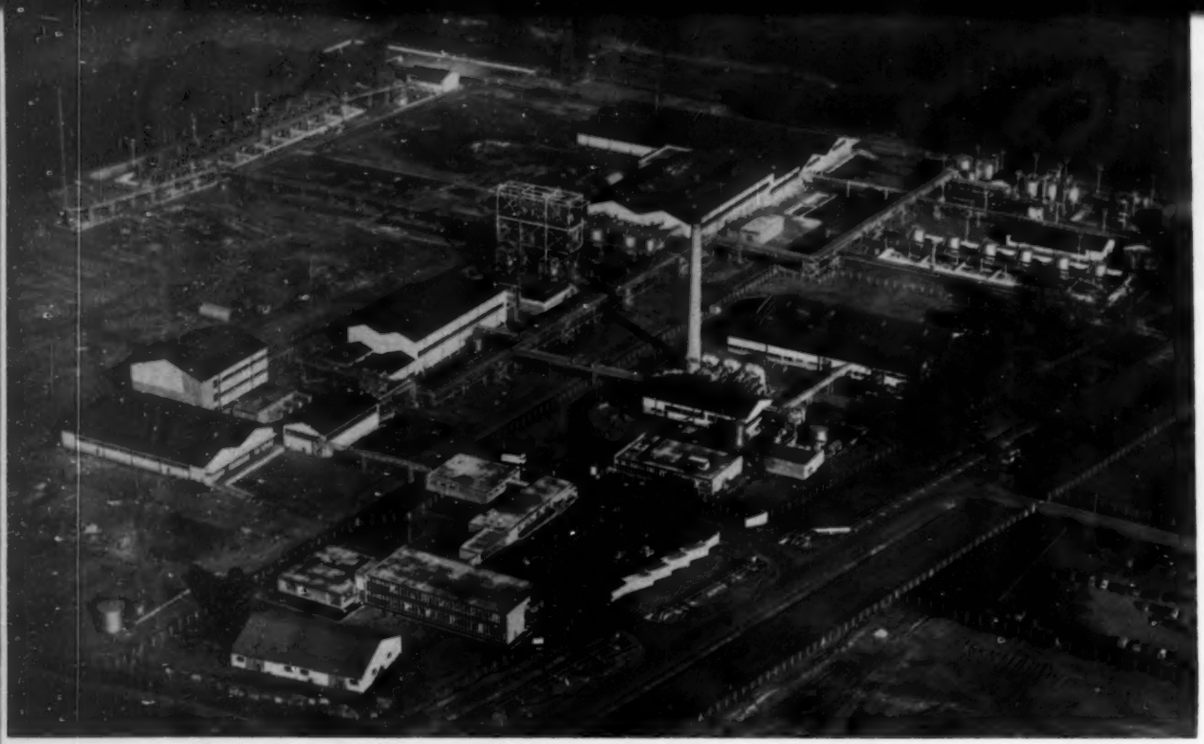


International Synthetic Rubber Co.'s expanded plant at Hythe, (Southampton), United Kingdom.

The world's petrochemical plants

North America

Canada

B-A SHAWINIGAN LTD. Montreal, Que., Canada. Plant manager, R. B. Walker.
Raw material: cumene.
Products: phenol, more than 30 million lb/yr; acetone, more than 17 million lb/yr; isopropanol, methyl styrene, bis-phenol.

BORDER CHEMICALS LTD. is building a $550,000 sulfuric acid plant in the Winnipeg, Man., area. Completion will be in July, 1960.

BRITISH AMERICAN OIL CO. LTD. Dick Lake and Homeglen-Rimbey fields, Alberta, Canada, is building a 326 mmcf/d gas processing plant, which will produce 233 long ton/day sulfur. Completion: November, 1960. Contractor: Poole-Pritchard. Cost: $12.5 million.

BRITISH AMERICAN OIL CO. LTD., Montreal, Que., Canada.
Raw material: propylene and benzene.
Product: cumene, 600 b/d.

BRITISH AMERICAN OIL CO. LTD. Nevis field, Alberta, Canada.
Raw material: natural gas.
Product: sulfur.

BRITISH AMERICAN OIL CO. LTD. Pincher Creek, Alberta, Canada.
Raw material: natural gas.
Product: sulfur, 690 long ton/day.

BROCKVILLE CHEMICALS, LTD. (subsidiary of Sogemines Ltd.), plans a $17 million plant at Brockville (Maitland), Ont., Canada, to produce ammonia, nitrogen chemicals, and hydrogen. Company has awarded a contract to P. G. Engineering Co. for construction of a 15 mcf/d plant, using Texaco partial oxidation process and operating on natural gas from western Canada.

CABOT CARBON CO. OF CANADA LTD. Sarnia, Ont., Canada. Plant manager, W. F. Hendricks.
Raw materials: petroleum fractions.
Products: oil-type furnace black, more than 55 million lb/yr.

CALIFORNIA STANDARD CO. Homeglen-Rimbey field, Alberta, Canada, is building a 120 mmcf/d gas processing plant which will produce 300 long ton/day sulfur. Completion, late 1960. Cost, about $17 million.

CANADIAN CHEMICAL CO. LTD., Edmonton, Alta., Canada. Plant manager, J. C. Langford.
Raw materials: Butane and propane.
Products: pentaerythritol, methanol, propanol, other alcohols, mono- and di-propylene, glycol, propyl acetate, acetic acid, acetone, aldehydes, ketones, cellulose acetates.
A $4 million expansion, to be completed early in 1961, will increase productive capacity by 40%.

CANADIAN INDUSTRIES, LTD. Beloeil, Que., Canada, is scheduled to complete a $500,000 plant this year for production of pentaerythritol tetranitrate, the first such plant in Canada.

CANADIAN INDUSTRIES LTD. Edmonton, Alta., Canada. Works manager, S. T. Jones.
Raw material: natural gas.
Product: polyethylene, 40 million lb/yr.

CANADIAN INDUSTRIES LTD., Millhaven, near Kingston, Ont., Canada.
Raw material: fuel oil, ethylene glycol, terephthalic acid.
Products: anhydrous ammonia, 200 ton/day; synthetic polyester fiber and flake, "Terylene."

CANADIAN OIL COS. LTD. Corunna, near Sarnia, Ont., Canada.
Raw material: refinery streams.
Products: benzene, toluene, xylenes, aromatic solvents, paraffinic solvents, hydrogen, methane, ethane, ethylene, propane-propylene, butane-butylene.

CANADIAN OIL COS. LTD. is building a gas processing plant in the Innisfail field, Alberta, which will produce about 80 long ton/day of sulfur. Completion, Nov., 1960. Cost: about $4 million.

CARBIDE CHEMICALS CO., Montreal East, Que., Canada.
Raw material: refinery gases.
Products: ethylene; ethylene oxide; ethylene glycols, 50 million lb/yr; polyethylene glycols; glycol ethers; ethanolamines; and polyethylene, 40 million lb/yr.
Polyethylene capacity will be raised to 65 million lb/yr by mid-1960.

COLUMBIAN CARBON (CANADA) LTD. Toronto, Ont., plans a carbon black plant with an initial capacity of 40 million lb/yr, to begin operations in 1961. Site was not disclosed.

CONSOLIDATED MINING & SMELTING CO. OF CANADA LTD. Turner Siding and Calgary, Alta., Canada. Superintendent at Calgary, R. S. Woodford.
Raw material: natural gas.
Products: ammonia, 325 ton/day; ammonium nitrate, 200 ton/day; sulfur, 20 ton/day.
A $5 million, 36,000 ton/yr urea plant is scheduled for completion in Calgary in 1960.

CYANAMID OF CANADA LTD. Welland (Hamilton Bay), Ont., Canada, will complete this year a $5 million project to convert to natural gas from coal as a raw material for manufacture of ammonia, ammonium nitrate and urea. Rated capacities are: ammonia, 52,500 ton/yr; urea, 66,000 ton/yr; nitric acid, 68,400 ton/yr.

DEVON-PALMER OILS LTD, and TEXAS GULF SULFUR CO. INC. Calgary, Alta., Canada.
Raw material: natural gas.
Product: sulfur, 370 long ton/day.

DOW CHEMICAL CO. OF CANADA LTD. is constructing a new plant at Fort Saskatchewan, Alta. The first units will produce ethanolamines, glycols, and pentachlorophenol; the pentachlorophenol unit is expected to be in operation late in 1960, the others in summer 1961. Robert T. Richardson is works manager.

DOW CHEMICAL CO. OF CANADA LTD. Sarnia, Ont., Canada.
Raw material: petroleum hydrocarbon streams, benzene, and butadiene.
Products: carbon tetrachloride, diethanolamine, diethylene glycol, dichloroethyl ether, ethanolamine ethyl chloride, ethylene oxide, ethylene glycol, perchloroethylene, styrene, polystyrene, styrene-butadiene latex, trichloroethylene, triethanolamine, triethylene glycol, polyethylene, and ammonia.
Consideration is being given to vinyl chloride facilities.

DOW CHEMICAL CO. OF CANADA LTD. is planning a phenol plant at Vancouver, British Columbia, Canada. Ernest N. Banks is operations manager.

DU PONT CO. OF CANADA LTD., Maitland, Ont., Canada.
Raw materials: cyclohexane, ammonia, carbon tetrachloride, chloroform, polyacrylonitrile, hydrofluoric acid.
Products: adipic acid, hexamethylene diamine, chlorofluoromethanes, acrylic fiber, hydrogen peroxide.

DU PONT CO. OF CANADA LTD. Sarnia, Ont., Canada, is scheduled to start up this year a new low pressure polyethylene plant.

ETHYL CORP. OF CANADA LTD. Sarnia, Ont., Canada.
Raw materials: ethane and ethylene.
Product: tetraethyl lead anti-knock compounds.
Construction: an ethyl chloride-ethylene dichloride unit. Second phase to be completed in September.

IMPERIAL OIL LTD. Redwater, Alberta Canada.
Raw material: natural gas.
Product: sulfur, 11 to 25 ton/day.

IMPERIAL OIL LTD. Sarnia, Ont., Canada.
Raw materials: petroleum gas and liquid streams.
Products: tripropylene, tetrapropylene, detergent alkylate (30 million lb/yr of alkyl aryl benezene), alkylate bottoms, aliphatic solvents, ethylene, propylene, butadiene (18,000 ton/yr), butylenes, aromatic distillates and tars, petroleum polymers.

IRVING REFINING LTD., St. John, New Brunswick, Canada.
Raw material: refinery gases.
Product: sulfur, 30 long ton/day.

JEFFERSON LAKE PETROCHEMICALS OF CANADA LTD., Coleman, Alberta, Canada, is planning a gas processing plant for gas from Savanna Creek field, which will produce about 550 long ton/day. Investment cost is approximately $3 million. $20 million (entire plant.)

JEFFERSON LAKE PETROCHEMICALS OF CANADA LTD., East Calgary field, Alberta, Canada, plans a gas processing plant which will produce about 350 long ton/day of sulfur. Completion, a possibility for 1960 or 1961. Cost (entire plant), about $10 million.

JEFFERSON LAKE PETROCHEMICALS OF CANADA LTD., Fort St. John, British Columbia, Canada.
Raw material: natural gas.
Product: sulfur, 300 ton/day.

LAURENTIDE CHEMICALS & SULFUR LTD., Montreal East, Que., Canada.
Raw materials: natural gas and refinery gases.
Product: sulfur: 100 ton/day or more.

LUBRIZOL OF CANADA LTD., Niagara Falls, Ont., Canada.
Raw material: petroleum fractions.
Products: lube oil additives.

MONSANTO CANADA LTD. Montreal, Que., Canada.
Raw material: styrene.
Product: polystyrene, 20 million lb/yr.
A new 6 million lb/yr maleic anhydride unit is scheduled for completion late this year.

NEVIS OPERATORS COMMITTEE, Nevis, Alberta, will complete this year a 43 mmcf/d gas processing plant, including sulfur recovery at 125 ton/day. Investment cost is approximately $3 million. Fluor is the contractor.

NEW SURPASS PETROCHEMICALS LTD., Scarborough, Ont., Canada.
Raw materials: petroleum fractions, polyalkylated benzene, oxidates.
Products: petroleum sulfonates and derivatives, oil additives, corrosion inhibitors, rust preventives, greases.

NORTHWEST NITRO-CHEMICALS LTD. Medicine Hat, Alta, Canada.
Raw material: natural gas.
Products: ammonia, nitrogen, and phosphate fertilizers.

POLYMER CORP. LTD. Sarnia, Ont., Canada. Vice President, L. D. Dougan.
Raw materials: refinery streams.
Products: styrene, butadiene, butadiene-styrene and butyl and nitrile type rubbers, ethylene, isobutylene, (total rubber production about 135,000 long ton/yr.).

REICHHOLD CHEMICALS (CANADA) LTD. Port Moody, British Columbia, Canada, plans facilities for phenol and formaldehyde production.

REICHHOLD CHEMICALS (CANADA) LTD. Ste. Therese, Que., Canada, is building a new phthalic anhydride unit with a capacity of 7 million lb/yr.

ROYALITE OIL CO LTD. Turner Valley, Alta, Canada.
Raw material: natural gas.
Product: sulfur, 25 to 40 ton/day.

ST. MAURICE CHEMICALS, Division of Shawinigan Chemicals Ltd. Varennes, Que., Canada.
Raw material: methanol.
Products: formaldehyde, pentaerythritol.

British Hydrocarbon Chemicals Ltd.'s Grangemouth, Scotland, plant showing phenol/acetone and cumene units.

SHELL OIL CO. OF CANADA LTD. Jumping Pound, Alta., Canada.
Raw material: natural gas.
Product: sulfur, 90 long ton/day.

SHELL OIL CO. OF CANADA LTD. Montreal, Que., Canada. Superintendent, R. Wiens.
Raw materials: propylene, butylenes, benzene.
Products: isopropanol, acetone, sec-butanol, methyl ethyl ketone, epoxy resins (3 million lb/yr), detergent alkylate. Total capacity all products, approximately 40 million lb/yr.

SHERRITT GORDON MINES LTD. Fort Saskatchewan, Alta., Canada.
Raw material: natural gas.
Products: ammonia, 180 ton/day; ammonium sulfate, 100,000 ton/yr.

STEELMAN GAS LTD., Steelman, Saskatchewan, Canada.
Raw material: natural gas.
Product: sulfur, 7.5 long ton/day.

SUN OIL CO. LTD. Sarnia, Ont., Canada.
Raw materials: refinery streams.
Product: butylenes.

TEXACO CANADA LTD., Montreal East, Que., Canada.
Raw material: refinery gases.
Product: ethylene.

TEXACO CANADA LTD., Edmonton, Alta., Canada.
Raw materials: propane-butane.
Products: feedstocks for petrochemicals.

Mexico

PETROLEOS MEXICANOS, Atzcapotzalco, near Mexico City, Mexico.
Raw materials: refinery streams.
Products: sulfur, 25 ton-day; dodecylbenzene, 45 ton/day.
Under construction, a 6,800 ton/yr, low pressure (Phillips license) polyethylene plant.

PETROLEOS MEXICANOS, Ciudad Madero, near Tampico, Mexico. Superintendent: Ing. Francisco L. Corcuera.
Products: sulfur, 10,000 ton/yr; tetramer, 11,000 ton/yr; alkylbenzene, 11,000 ton/yr.
Construction of a synthetic rubber plant is planned for 1961. New refinery construction at Tampico includes a 35 ton/day sulfur unit, to be completed in October, 1960.

PETROLEOS MEXICANOS, Minatitlan, Mexico.
Under construction: a 5,300 b/d aromatics recovery plant (benzene, toluene, xylenes, ethylbenzene), and a 200 ton/day ammonia plant, products from which will be converted to solid fertilizers by a private company.

PETROLEOS MEXICANOS. Poza Rica, Mexico.
Raw material: sour natural gas.
Product: sulfur, 150 ton/day.

PETROLEOS MEXICANOS, Salamanca, Mexico, is constructing a 200 ton/day anhydrous ammonia plant. The Lummus Co. has contract.

PETROLEOS MEXICANOS, Tampico, is considering construction of a carbon black plant.

SINTESIS ORGANICAS, Mexico City, Mexico.
Raw material: napthalene.
Product: phthalic anhydride.

Central and South America

Argentina

CARBOMETAL, Mendoza, Argentina, is planning the following facilities: polyvinyl chloride, 4,500 ton/yr; acetylene, 200 ton/yr; plastics, 7,500 ton/yr.

CIA. NACIONAL PARA LA INDUSTRIA QUIMICA (ATANOR), Rio Tercero, Cordoba Prov., Argentina, plans to shift from charcoal to natural gas as raw material for its methanol production, and to increase capacity to 12,000 ton/yr.

DELTA OIL CO. has requested 60 acres of land from the Army Ordnance Works at a location near San Nicolas, Buenos Aires Province, Argentina, for erecting a plant to manufacture petroleum and tar derivatives.

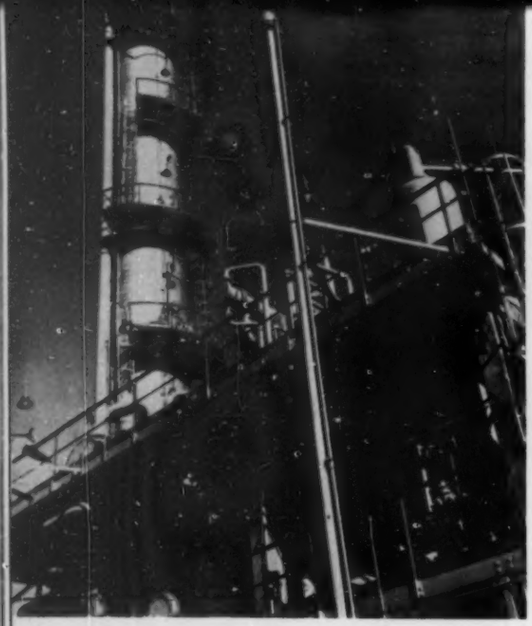
DIADEMA ARGENTINA S.A. DE PETROLEO (Shell) reportedly is giving consideration to entering manufacture in Argentina of a line of petrochemicals, although no announcements have been made.

ELECTROCHLOR, owned jointly by Duperial (Imperial Chemical Industries) and Cellulosa Argentina (Italian group Pomiglio), will enlarge its ammonia plant in Juan Ortiz near San Lorenzo, Santa Fe, Argentina, to 20,000 ton/yr, and will shift to natural gas as its raw material.

ESSO S.A.P.A. is reportedly giving strong consideration to entering manufacture in Argentina of a line of petrochemicals, though no announcements have been made.

INDUSTRIAS PLASTICAS ARGENTINAS KOPPERS S.A. La Plata, near Buenos Aires, Argentina.
Raw materials: refinery gases.
A $24 million plant is planned for completion in 1961, ethylene; polyethylene, 15 million lb/yr; styrene, 33 million lb/yr.

INDUSTRIAL QUIMICAS S.A. INDUSTRIAL Y COMMERCIAL (DURANOR), formed recently by Hooker Chemical Corp. and Cia. Nacional para la Industria Quimica (ATANOR), will complete a 25



Partial view of the new 40 million lb/yr polypropylene plant of Humble Oil & Refining Co. in Baytown, Texas, which went into operation late this spring.

metric ton/day phenol plant at Rio Tercero, Cordoba, Argentina, in about two years.

MONSANTO ARGENTINA S.A. Buenos Aires, Argentina is building a phthalic anhydride plant at Zarate, near Buenos Aires. Completion date: 1960.

TEXAS BUTADIENE & CHEMICAL CORP. Comodoro Rivadavia, Argentina.
Raw material: natural gas, styrene (from Koppers).
A $40 million plant scheduled for completion in 1962: butadiene, 30,000 ton/yr; synthetic rubber, 40,000 ton/yr; and carbon black.

A group comprising Fiat and Montecatini has requested 200 acres of land near San Nicolas, Buenos Aires Province, Argentina, from the Army Ordnance Work, for a petrochemical plant which would produce 18,000 ton/yr of urea, 94,000 ton/yr of ammonium nitrate, 10,000 ton/yr of dodecyl benzene, 2,000 ton/yr of phthalic anhydride, and 35,000 ton/yr of sulfuric acid.

Brazil

ADESIVOS E LACTICINIOS BRASIL-AMÉRICA (ALBA S/A). Caixa Postal 438, São Paulo, Brazil. Works manager, John V. Lynn.
Hydrocarbon raw materials: Bunker C fuel oil.
Products: Methanol, 7,500 metric ton/year.

BAKOL COMERCIO E INDUSTRIA S.A. Sao Paulo, Brazil.
Product: styrene, 10,000 ton/yr.

COMPANHIA BRASILEIRA DE ESTIRENO (subsidiary of Koppers Co.), Sao Paulo, Brazil.
Product: styrene, 5,000 ton/yr.

COMPANHIA DEODORO INDUSTRIAL. Sao Paulo, Brazil.
Product: Urea and formaldehyde, 4,500 ton/yr.

COMPANHIA PETROQUIMICA BRASILEIRA (associated with the Columbian Carbon Co. and Celanese Corp.), Sao Paulo, Brazil.
Product: Carbon black, 18,000 ton/yr.

COMPANHIA QUIMICA RHODIA BRASILEIRA (associated with Soc. Chimique du Rhone-Poulenc), Sao Paulo, Brazil.
Products: vinyl acetate, 4,000 ton/yr; nylons, 2,160 ton/yr.

CONTINENTAL CARBON-CELANESE is building a carbon black plant in Brazil, site not revealed.

DENTARIA BRASILEIRA INDUSTRIA E COMERCIO. Rua Tito, Sao Paulo, Brazil.
Product: acrylic resins, 75 ton/yr.

S.A. GEON DO BRASIL INDUSTRIA E COMERCIO, Sao Paulo, Brazil.
Product: polyvinyl chloride, 12,000 ton/yr.

INDUSTRIA CHEMICAL BRAZIL plans a Ziegler type plant to manufacture polyethylene, site not disclosed.

INDUSTRIAS QUIMICAS ELECTRO-CLORO S.A. Sao Paulo, Brazil.
Product: polyvinyl chloride, 10,000 ton/yr.

INDUSTRIAS QUIMICAS RESANA S.A. Sao Paulo, Brazil.
Product: maleic anhydride, 720 ton/yr.

VIDROPLAS COMPANHIA INDUSTRIAL DE PLASTICOS, Sao Paulo, Brazil.
Product: polyesters, 1,200 ton/yr.

NORTH AMERICAN SOLVAY INC. Sao Paulo, Brazil.
Under construction: a low-pressure polyethylene unit, completion scheduled for 1961.

PETROLATOS ZILCO LTDA. Rio de Janiero, Brazil.
Products: methanol and formaldehyde, 9,000 ton/yr.

PETROLEO BRASILEIRO S.A. (PETROBRAS), Cubatao, near Sao Paulo, Brazil.
Raw material: refinery gases.
Products: benzene, sulfuric acid, ammonia, carbon black, ethylene, propylene, nitric acid, nitrogenous fertilizers.

PETROLEO BRASILEIRO S.A. (PETROBRAS), near Rio de Janeiro, Brazil, is constructing a $6 million, 40,000 ton/yr GRS type snythetic rubber plant, adjacent the new Duque de Caxias refinery now being built. Petrobras will also install a benzene-toluene-xylenes unit and an ethylene recovery unit at this plant.

QUIMICA INDUSTRIAL BRASILEIRA S.A. Sao Paulo, Brazil.
Product: phenol, 3,000 ton/yr.

REFINARIA E EXPLORACAO DE PETROLEO "UNIAO" S.A., Capuava, Sao Paulo, Brazil.
Products: benzene, tetramer, sulfur, ammonia, methanol, higher alcohols, acetylene, vinyl derivatives, carbon black, solvents.

UNION CARBIDE. Cubatao, near Sao Paulo, Brazil.
Raw material: refinery streams.
Product: polyethylene, 4,500 ton/yr.
Company has requested government approval to increase capacity to 11,000 ton/yr.

Chile

REFINERIA CHILENA DE PETROLEOS y PETROQUIMICA S.A. Correo Estación Maipú, Santiago, Chile. Manager, Arturo Sramek.
Hydrocarbon raw material: refinery streams.
Products: aliphatic solvents, aromatic solvents, additives.

Colombia

INDUSTRIA COLOMBIANA DE FERTILIZANTES (Montecatini), Barrancabermeja, Colombia. General manager, Dario Trujillo.
Raw material: natural gas.
Products: ammonia, ammonium nitrate, nitric acid, and urea.

INTERNATIONAL PETROLEUM CO. (COLOMBIA) LTD. will build a $13 million, 300 ton/day ammonia and 150 ton/day nitric acid plant at the Cartegena, Colombia refinery.

Costa Rica

FERTILIZANTES DE CENTRO AMERICA (FERTIGAS) etal, plans a $10 million, 650 ton-day nitrogenous fertilizers plant at an undisclosed site in Costa Rica. Products will include urea.

Peru

FERTILIZANTES SINTETICOS S.A. Lima, Peru. Manager, Enrico Berrini.
Hydrocarbon raw material: Bunker No. 6 oil.
Products: ammonia, 200 ton/yr; ammonium sulfate, 20,000 ton/yr; ammonium nitrates, 32,500 ton/yr; nitric acid (98%), 1,300 ton/yr; hydrogen, 100,000 cu. meter/yr; oxygen, 1,000,000 cu.m./yr; ammonia liquor, 100 ton/yr.

Puerto Rico

GONZALEZ CHEMICAL INDUSTRIES INC., San Juan, Puerto Rico, vice president, R. Ogilvie, has announced plans to build an ammonia plant.

UNION CARBIDE INC. plans a $20 million, 110 million lb/yr polyethylene plant at a site near Ponce, Puerto Rico, with completion expected in second half of 1962.

Trinidad

FEDERATION CHEMICALS LTD. (associated with W. R. Grace & Co.), Point Lisas, near Point-a-Pierre, Trinidad, plans an anhydrous ammonia plant, operating on natural gas and producing also nitrogen, ammonium sulfate (245 ton/day), urea and sulfuric acid.

Uruguay

ADMINISTRATION NATIONAL DE COMBUSTIBLES ALCOHOL Y PORTLAND, Montevideo, Uruguay, is building a 6 ton/day, sulfur plant.

Venezuela

INSTITUTO VENEZELANO DE PETROQUIMICA, Caracas, Venezuela, general manager, Dr. Gustavo Rivero N., will complete by 1961 at Moron, Venezuela, a new petrochemical plant to operate on Barinas crude and natural gas. Products and output in metric ton/yr are: ammonia, 33,000; ammonium nitrate, 49,830; ammonium sulfate, 79,200; and urea, 16,500.

NEGROVEN, Moron, Venezuela will complete in July of this year a 2.4 million, 20 million lb/yr carbon black plant (licensed by United Carbon Co., Inc.).

Western Europe

Austria

DANUBIA PETROCHEMIE A.G. Schwechat, near Vienna, Austria, will complete a 5,000 ton/yr polypropylene plant in 1960. Charge stock will come from new government refinery being built nearby.

FARBWERKE HOECHST A.G. has indicated plans for a new petrochemical plant at Schwechat, near Vienna, Austria. No further information was disclosed.

HAIG WERKE A.G., Austria.
Product: methanol.

Belgium

AMOCO FINA is planning a petroleum additives plant at Antwerp, Belgium, for probable completion in 1961.

BRITISH CHROME & CHEMICALS is building a 100 ton/day sulfuric acid plant at Urlay Nook, Belgium, with completion expected this year.

CARBOCHIMIQUE expects to complete this year a plant at Tertre, Belgium, with the following facilities: 100-150 ton/day ammonia via Texaco partial oxidation process.

COBENAM S.A. Antwerp, Belgium, expects to complete a 30 million lb/yr polyethylene plant this year.

MONSANTO CHEMICAL CO. and **SOC. INDUSTRIELLE LA CELLULOSE S.A. (SIDAC)** have formed a new company, with headquarters in Brussels, Belgium, and will build a plant at Ghent to manufacture polyvinyl butyral plastic sheets. Completion planned by 1961.

SOC. CHIMIQUE DES DERIVES DU PETROLE, Antwerp, Belgium.
Products: ethylene oxide.

UNION CHIMIQUE BELGE will complete a 5,000 ton/yr, $2 million phthalic anhydride plant at Schoonarde, Belgium, fall-1960. Badger N.V. has the contract.

France

ANTAR PETROLES DE L'ATLANTIQUE. Donges, France.
Raw materials: aromatic and paraffinic hydrocarbons.
Products: benzene, toluene, xylenes, propylene, paraxylene, and solvents.
Expansion in capacity planned by 1962.

CIE FRANCAISE DE RAFFINAGE, Gonfreville, France.
Products: ethylene, 30,000 ton/yr; tri- and tetrapropylene; heptane.

CIE FRANCAISE DE RAFFINAGE, La Mede, France.
Product: propylene.

CIE FRANCAISE DU CARBON BLACK S.A. (Continental Carbon and Phillips Petroleum), Bec d'Ambes, Bordeaux, France, will complete a 25,000 ton/yr carbon black plant late in 1960.

ESSO STANDARD S.A.F., Port Jerome, France. General manager, J. Ballet.
Raw material: propylene.
Products: tri- and tetra-propylene.
Under construction: facilities for ethylene, propylene, butadiene (9,000 ton/yr), dodecylbenzene, lubricants, additives.

ETHYLENE PLASTIQUES-NORMANDIE, Port Jerome, France.
Product: high pressure polyethylene.

ETHYLENE PLASTIQUE-NORMANDIE plans a high pressure polyethylene plant at Lacq, France, by 1962.

KUHLMANN, Paimboeuf, France.
Raw material, fuel oil.
Product: ammonia, methanol.

LORRAINE-DIEUZE, Moselle, France, is building polyethylene facilities.

MANUFACTURE NORMANDE DE POLYETHYLENE (MANOLENE), Gonfreville, France.
Raw material: ethylene.
Product: polyethylene.

METHANOLACQ, Lacq, France, will complete this year a 100 ton/day synthetic methanol plant to operate on residual gas from the Aquitaine Chimie plant at Lacq.

NAPHTACHIMIE, Lavera, France.
Raw materials: naphtha and kerosine.
Products: ethylene; propylene; butadiene; ethylene oxide, 13.2 million lb/yr; ethylene glycol, 5.5 million lb/yr; ethanolamines, 5.5 million lb/yr; glycol ethers etc., 2.2 million lb/yr; acetone, 11 million lb/yr; isopropanol, 19.8 million lb/yr.
Construction: 6,000 ton/yr ethylene oxide plant, with completion scheduled in 1960. A 6,000 ton/yr butadiene plant is planned. Company also plans to manufacture polyisobutylene under a Cosden Petroleum license.

NOBEL-BOZEL, Port Jerome, France.
Raw material: refinery gas.
Product: sulfur.

OFFICE NATIONAL INDUSTRIEL DE L'AZOTE, Toulouse, France.
Raw material: heavy fuel oils.
Products: acetylene, ammonia, methanol.

PECHINEY, St. Auban, France.
Raw material: propane.
Products: perchlorethylene, carbon tetrachloride.
Construction: a 2 million lb/yr polypropylene unit (Montecatini license).

PIERREFITTE, Pierrefitte, France.
Raw material: natural gas.
Product: ammonia.

PLASTICHIMIE S.A. (associated with Dow Chemical International Ltd. S.A.) is building a polystyrene plant at Ribecourt, France. Completion date: 1961.

POTASSE ET ENGRAIS CHIMIQUES, Grand Couronne, France.
Product: ammonia and derivatives.

REICHOLD CHEMICALS INC., Niort, France, is building a 73,000 ton/yr formaldehyde plant.

RHODIACETA, St. Fons, France, plans a plant to produce terephthalates from paraxylene and ethylene glycol.

ST. GOBAIN, Balaruc, France.
Raw material: refinery gas.
Product: sulfur.

ST. GOBAIN, Port de Bouc, France.
Raw material: refinery gas.
Product: sulfur.

SHELL-ST. GOBAIN, Berre, France.
Raw materials: refinery gases and liquids.
Products: isopropanol, diacetone, alcohol, butyl acetone, epoxy resins, carbon black, detergent bases, solvents.
A new 50,000 ton/yr SBR synthetic rubber plant is scheduled for completion in 1961.

SHELL-ST. GOBAIN, Petit Couronne, France.
Raw material: O_5+ plus kerosine.
Product: alkyl sulfate of soda (for use in detergents).

SOC. ATLANTIQUE PROGIL ELECTROCHIMIE, Donges, France.
Raw materials: propylene and benzene.
Product: cumene.

SOC. CABOT-FRANCE, Berre, France. President, Denis E. O'Mulloy.
Product: carbon black, 35,000 ton/yr.

SOC. CHIMIQUE DE LA GRANDE PAROISSE, Grand Quevilly, France.
Raw material: refinery gas.
Product: ammonia and derivatives.

SOC. CHIMIQUE DES DERIVES DU PETROLES, France, plans an ethylene oxide plant, location not disclosed.

SOC. DE PRODUCTS CHIMIQUES COURRIERES-KUHLMANN, Harnes, France.
Raw materials: butylene and propylene dimers, and propylene trimers.
Products: dodecylbenzene and oxo alcohols.

SOC. DE PRODUITS CHIMIQUES MARLES-KUHLMANN, Choques, France.
Raw material: propylene.
Products: propylene oxide and derivatives (for use in polyester resins).

SOC. DE PRODUITS CHIMIQUES MARLES-KUHLMANN, Gonfreville, France, is building facilities for ethylene oxide and derivatives.

SOC. DES PRODUITS AZOTES (AZOLACQ), Lannemezan, France.
Products: ammonia, urea, nitrogen fertilizers.

SOC. DES PRODUITS CHIMIQUES D'AQUITAINE (AQUITAINE-CHEMIE), Lacq, France, will complete a polypropylene unit this year, and plans an acetylene, methanol, and ammonia plant in the near future.

SOC. DES USINES CHIMIQUES RHONE-POULENC, Peage de Roussillon, France.
Raw materials: propylene, benzene, cumene.
Products: cumene, acetone, phenol.

SOC. DU CAOUTCHOUC BUTYL (SOCABU), Port Jerome, France.
Raw material: isobutylene.
Product: butadiene, and butyl rubber (20,000 ton/yr).

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SOC. INDUSTRIELLE DES DERIVES DE L'ACETYLENE (SIDA). La Chambre, France.
Raw materials: isopropanol, sec-butanol.
Products: diacetone alcohol, acetone, and methyl ethyl ketone.

SOC. INDUSTRIELLE DES DERIVES DE L'ACETYLENE (SIDA). Notre Dame de Granvenchone, France, will complete a sec-butanol plant this year.

SOC. NATIONALE DES PETROLES D'AQUITAINE, Lacq, France.
Raw material: natural gas.
Products: sulfur, 4,000 ton/day, and ethylene, 25,000 ton/yr.
Plans have been made for facilities for acetylene, methanol and ammonia.

SOC. NORMANDE DE MATIERE PLASTIQUE, Port Jerome, France.
Product: low pressure polyethylene.
Construction: a 22 million lb/yr polypropylene plant (Montecatini license).

SOC. PETROSYNTHESE. Gonfreville, France.
Raw materials: benzene, tetrapropylene.
Product: dodecylbenzene.

SOC. PROGIL-ELECTROCHIMIE. Pont de Claix, France.
Raw material: cumene.
Products: acetone and phenol.
Under construction: units to produce perchlorethylene and carbon tetrachloride.

SOC. STANDARD-KUHLMANN, l'Estane, France.
Raw materials: aromatic alkyls.
Products: detergents, 19.8 million lb/yr.

UNITED CARBON—FRANCE S.A. will complete early in 1961 a new $5 million, 50 million lb/yr carbon black plant at Port Jerome, France.

Germany (West)

BADISCHE ANILIN-UND SODA-FABRIK, Ludwigshafen, West Germany.
Products: styrene, polyethylene, methanol, isopropanol, acetone.

B.P. BENZIN UND PETROLEUM A.G., Dinslaken, West Germany, plans an ethylene plant.

BUNAWERKE HUELS GmbH. Marl Kreis, Recklinghausen, West Germany. Chairman, supervisory board, Paul Baumann.
Hydrocarbon raw material: n-butane.
Products: SBR synthetic rubber, 70,000 ton/yr.

CARBOSULF (a joint venture of Glanzstoff Courtaulds and Dr. Jacob, Chemische Fabrik) will build a 105 million lb/yr carbon disulfide plant at Cologne, West Germany.

CHEMISCHE WERKE HOLTEN, Oberhausen, West Germany.
Products: ethylene oxide, ethylene glycols, estimated total capacity 44 million lb/yr.

CHEMISCHE WERKE HUELS A.G. Marl Kreis, Recklinghausen, West Germany. Chairman, Paul Baumann.
Principal products: chlorinated hydrocarbons, solvents and resins, detergent materials, glycols and derivatives, ethanol, carbon black, plastics, and plasticizers, butadiene (40,000 ton/yr.).
Huels plans to produce polybutadiene, using Ziegler-type catalyst under license from Studiengesellschaft Kohle GmbH. Company also plans a 6,000 ton/yr Ziegler process polyethylene plant.

DEUTSCHE ERDOEL, Heide, West Germany.
Product: ethylene, 2 million lb/yr.

DEUTSCHE SHELL, near Cologne, West Germany.
Raw material: refinery gas.
Product: ethylene.

ERDOELCHEMIE GmbH. Dormagen/Niederrhein, West Germany. Manager, Dr. Wilhelm Graulich.
Hydrocarbon raw material: light petroleum distillate.
Products: ethylene, 45,000 ton/yr; propylene, 40,000 ton/yr; ethylene oxide, 36,000 ton/yr; propylene oxide, 10,000 ton/yr.
Units under construction for completion in 1961: butadiene, 30,000 ton/yr; di- and tri-isobutylenes, 35,000 ton/yr; n-butenes, 40,000 ton/yr; glycols, 26,000 ton/yr.

ESSO A.G., Cologne. West Germany.
Raw material: refinery streams.
Products: butadiene, 7,500 ton/yr; propylene, 35,000 ton/yr; ethylene; isobutylene; methane, ethane, hydrogen, acetylene.

FARBWERKE HOECHST A.G. Gendorf, West Germany.
Products: ethylene oxide, ethylene glycol, other glycols and derivatives, detergents, nylon, antifreezes, emulsifiers, textile and agricultural chemicals, polyvinyl chloride, polypropylene, and other plastics, chloromethane.

FARBWERKE HOECHST A.G. Hoechst, West Germany.
Raw material: petroleum distillates.
Products: ethylene, propylene, ethanol, isopropanol acetone, polyethylene, polypropylene, fibers, films.
New ethylene and acetylene units under construction will raise total olefin capacity at Hoechst to about 130 million lb/yr.

FARBENFABRIKEN BAYER. Leverkusen, West Germany.
Products: rubber and fibers.

FELDMUBLE, Lulsdorf, West Germany, plans a 10,000 ton/yr. ethylene unit and a propylene unit.

HIBERNIA, Herne, West Germany.
Products: ethylene, polypropylene.

KOHLE-OEL-CHEMIE. Gelsenkirchen, West Germany.
Product: polyethylene.

PHENOLCHEMIE. Gladbeck, West Germany.
Products: phenol, acetone.

RHEINISCHE OLEFINWERKE, Wesseling, near Cologne, West Germany.
Raw materials: refinery gases, light naphthas.
Products: ethyl benzene, 12,000 ton/yr; epoxy resins, 2,000 ton/yr; ethylene, 102 million lb/yr; high pressure polyethylene, 35,000 ton/yr; low pressure polyethylene, 6,000 ton/yr.
Ethylene capacity will be expanded to about 275, million lb/yr by 1962.

RHEINPREUSSEN A.G. fuer BERGBAU UND CHEMIE. Homberg/Niederrhein, Baumstrasse 31, West Germany. Plant manager, Dr. Hermann Haeusser and Dr. Albert Meusel.
Products: i-propanol, sec-butanol, methyl ethyl ketone, dodecyl and keryl benzene and sulfonates, phthalic anhydride, oxo-alcohols, alkyl phenols, aluminum alcoholates, resins.

ROHM & HAAS, Darmstadt, West Germany.
Product: acrylic resins.

RUHRCHEMIE A.G. Oberhaussen-Holten, West Germany. Plant manager, Herr Knoellinger.
Under construction: polyethylene unit was reported.

SCHOLVEN-CHEMIE A.G., near Gelsenkirchen, West Germany plans a low pressure polyethylene plant.

UNION RHEINISCHE BRAUNKOHLEN-KRAFTSTOFF, Wesseling, West Germany. Managing director, Dr. Kurt Wissel.
Products: methanol, ammonia.
A new 9,000 ton/yr urea plant is planned.

WACKER CHEMIE. Burghausen, West Germany.
Products: thichloroethylene and vinyl acetate.

Greece

DOW CHEMICAL CO. plans a $1 million polystyrene plant at Athens, Greece by 1961; exact site not yet disclosed. Definite company name not yet decided.

THE GREEK GOVERNMENT expects to complete by mid-1962 at Ptolemaeus, Greece, the following units: ammonia, 300 ton/day; ammonium sulfate, 525 ton/day; and ammonium nitrate, 325 ton/day. Contractors are Uhde and Casale.

Italy

ASFALTI BITUMI CEMENTIC DERIVATI S.A. (ABCD). Ragusa, Italy.
Products: ethylene, propylene, butylene.
Nearing completion: 12,000 ton/yr. high pressure polyethylene plant. Will operate this year.

ANIC GELA SpA (AZIENDA NAZIONALE IDROGENAZIONE COMBUSTIBIL) will build facilities at Gela, Sicily, Italy to manufacture: sulfuric acid, 110,000 ton/yr; ammonium sulfate, 150,000 ton/yr; urea, 60,000 ton/yr; tetrapropylene, 4,000 ton/yr; polyethylene, 15,000 ton/yr; ethanolamines and glycols, 17,000 ton/yr.

ANIC SpA. Ravenna, Italy. General manager, Angelo Fornara.
Products: acetylene, butadiene, styrene, vinyl and polyvinyl chloride, acetaldehyde, synthetic rubber, carbon black, ammonia, nitric acid, ammonium nitrate, calcium nitrate, ammonium sulfate, urea, fertilizers, a polymer of acrylonitrile-butadiene-styrene.
Under construction: ethylene.

AZIENDE COLORI NAZIONALI AFFINI will complete a 22 million lb/yr phthalic anhydride plant at Milan, Italy, summer of 1960. Badger Mfg. Co. is the contractor.

COLUMBIAN CARBON EUROPA expects to complete a $6 million, 60 million lb/yr carbon black plant near Milan, Italy in 1961.

DISTILLERIE ITALIENNE plans an 11,000 ton/yr butanol plant near Milan, Italy.

DOW CHIMICA ITALIANA SpA is constructing polystyrene facilities at Livorno, Italy.

FTALITAL SpA., Scanzorosciate (Bergamo), Italy.
Products: phthalic and maleic anhydride.
Maleic capacity is being raised from present 1,500 to 10,000 ton/yr. Scientific Design Co. is the contractor.

MONTECATINI, Brindisi, Italy, has begun construction of a $95 million plant, to use approximately 1.3 million ton/yr of raw materials and produce; polyethylene, isotactic polypropylene, polymers for synthetic fiber, aldehydes, alcohols, and solvents. Completion is anticipated in early 1962.

MONTECATINI, Ferrara, Italy.
Raw materials: methane, liquid hydrocarbons, and refinery gases.
Products: ammonia, ethylene (30,000 ton/yr), propylene (30,000 ton/yr), polymers.
Polypropylene unit is undergoing expansion.

MONTECATINI, Novara, Italy.
Raw material: methane.
Products: ammonia, methanol, acetylene.

MONTECATINI, Rho, near Milan, Italy.
Raw materials: Liquid hydrocarbons and refinery gases.

MONTECATINI, Terni, Italy, is building a "Meraklon" polypropylene staple fiber and continuous thread plant, with an ultimate capacity of 30,000 ton/yr.

PHILLIPS CARBON BLACK ITALIANA SpA (a new company formed by Phillips Petroleum Co. and ANIC SpA), expects to complete by 1962 a new 25 million lb/yr carbon black plant. Plant site has not been disclosed.

SINCAT (affiliate of Industriale Catonese and Cia. Edison) Priolo, near Syracuse, Italy (Sicily).
Raw materials: refinery streams.
Products: ethylene, propylene, other olefins.
Planned: a 240 ton/day ammonia unit.

SIRE, Porto Torres, Sardinia, plans facilities to produce ethylene, propylene, ethanol, and propylene tetramer.

SIRE, Milan, Italy.
Product: dodecylbenzene.

SIRE, Varese, Italy.
Products: tetrapropylene, cumene, phenol.

SISAS, Milan, Italy.
Raw material: methane.
Products: acetylene, acetic derivatives.

SNIA VISCOSA, Varedo, near Milan, Italy, will complete a 20 million lb/yr carbon disulfide from natural gas plant in 1960.

SOCIETA ANONIMA RAFFINAZIONE OLII MINERALI (SAROM), Ravenna, Italy. General manager, Bruno Riffeser.
Products: sulfur, 34 ton/day.

SOC. CABOT ITALIANA, Ravenna, Italy, is building a $3 million, 14,000 ton/yr carbon black plant.

SOC. CHIMICA RAVENNA (associated with ANIC), Ravenna, Italy.
Product: vinyl chloride.

SOC. EDISON, Mantua, Italy.
Raw materials: liquid hydrocarbons and refinery gases.
Products: butadiene, 3,750 ton/yr; olefins, 25,000 ton/yr.

SOC. EDISON, Porto Marghera (Venice), Italy.
Raw materials: methane.
Products: ammonia, acetylene, acetic and vinyl derivatives.
Under construction: phenol-acetone unit.

SOC. SOLVAY, Rosignano, (near Livorno), Italy.
Product: polyethylene, 10,000 ton/yr.

SpA CELENE (owned jointly by Union Carbide and Soc. Edison), near Prioli, Sicily, expects to complete in 1960 facilities to produce polyethylene, ethylene oxide, propylene oxide, and derivatives. The polyethylene capacity is being expanded to 60 million lb/yr. Facilities will also be completed for manufacture of ethanol, butanol, 2-ethyl hexanol, and ethanolamines.

VETROCOKE, Marghera, Italy.
Raw material: methane.
Product: ammonia.

Netherlands

CALTEX PETROLEUM Mij (NEDERLAND), Pernis, the Netherlands.
Raw material: refinery gas.
Product: sulfur, 8 long ton/day.

CONTINENTAL CARBON — NETHERLANDS, Rotterdam, the Netherlands, is scheduled to complete this year its $2.5 million, 30 million lb/yr carbon black plant.

E. I. DU PONT DE NEMOURS & CO. plans a 15 million lb/yr acrylic fibers plant at Dordrecht, The Netherlands.

B. F. GOODRICH AND ALGEMEINE plans a butadiene plant at Arnheim, the Netherlands.

KETJEN CARBON LTD. Rotterdam, The Netherlands, is constructing a 28.6 million lb/yr carbon black plant.

KUNSTZIJDE UNIE N.V. plans a styrene plant in the Netherlands; site not disclosed.

NETHERLANDS STAATS MIJNEN is building low and high pressure process polyethylene plants in the Netherlands; sites not disclosed.

NEDERLANDSCHE DOW MIJ N.V. will complete a $2 million styrene-butadiene latex plant in the spring of 1961, at Botlek, Netherlands.

ROYAL DUTCH/SHELL GROUP, Pernis (Rotterdam), the Netherlands.
Raw material: refinery streams.
Products: sulfur, synthetic detergents, polyvinyl chloride, resins, solvents, insecticides, alkyl chloride, epichlorhydrin, synthetic glycerine, styrene-butadiene rubbers (60,000 ton/yr.).

Portugal

SOC. PORTUGUESA DE PETROQUIMICA SARL, Lisbon, Portugal, President: Antonio Herculano de Carvalho.
Products: ammonia, 61,050 ton/yr; fuel gas, and hydrogen.

Spain

COMPAÑIA INSULAR DEL NITROGENO S.A. Las Palmas, Canary Islands, Spain, plant manager, Eloy Sanson, is building a 110,000 ton/yr ammonium sulfate (from fuel oil) plant, with completion scheduled late in 1960.

INI, Puertollana, Spain, plans a low pressure process polyethylene plant.

REFINERIA DE PETROLEOS DE ESCOMBRERAS S.A. plans a $15 million, 90,000 ton/yr synthetic fertilizer plant for completion in 1962 at an undisclosed site in Spain.

SEVERAL GROUPS have made offers to develop petrochemical complexes in Spain. The Shell group, with its partner, Union Espanola de Explosivos, has offered to spend $56 million; Esso and its Spanish partner, Compania Espanola de Petroleos S.A. (Cepsa), have offered to spend $26 million; and Dow Chemical with its local affiliate, Unquinesa, is reported to have offered to spend $8 million. The Spanish government has not as yet announced a decision.

United Kingdom

BRITISH CELANESE CO. LTD. (Courtaulds Ltd.), Spondon, Derby, England.
Raw material: from thermal cracking (capacity recently increased by 40%).
Products: ethanol, isopropanol, acetone, butadiene, and aromatic hydrocarbons.

BRITISH GEON LTD., Barry, South Wales, England, will complete a $5.6 million expansion to the polyvinyl chloride plant during the second half of 1962.

BRITISH HYDROCARBON CHEMICALS LTD. (owned 50-50 by British Petroleum Co. Ltd. and Distillers Co. Ltd.). Grangemouth, Scotland. General manager, C. E. Evans.
Raw material: naphtha.
Products: ethylene, 60,000 ton/yr; ethanol, 70,000 ton/yr; diethyl ether; polyethylene, 11,000 ton/yr; propylene; isopropanol, 30,000 ton/yr; cumene, 30,000 ton/yr; acetone; tetrapropylene, 20,000 ton/yr; butadiene, 10,000 ton/yr; phenols, 12,000 ton/yr.
A new unit doubling the productive capacity for ethylene was scheduled for completion the middle of this year. Three new units costing $14 million are to be built for manufacture of butadiene, ethylene dichloride and methanol. Completion date: 1961.

BRITISH PETROLEUM CO. LTD., Grangemouth, Scotland.
Raw material: refinery gas.
Product: sulfur, 20 ton/day.

BRITISH PETROLEUM CO. LTD., Kent, England.
Raw material: refinery gas.
Product: sulfur, 45 ton/day.

CABOT CARBON LTD., Stanlow, Cheshire, England. Managing director, George H. Cash.
Raw material: petroleum fractions.
Product: carbon blacks, 55,000 ton/yr.

CHEMSTRAND LTD. Coleraine, Northern Ireland. General manager, T. H. Makepeace.
Product: acrylic fiber ("Acrilan").

DISTILLERS CO. LTD. plans a $5.6 million acetic acid plant, first of its kind in Europe, at Hull, England, with completion early in 1962, using a new process developed by the company, based on the direct oxidation of a light petroleum fraction.

DISTRENE LTD. (associated with Dow Chemical International), Barry, Wales, England.
Product: polystyrene.

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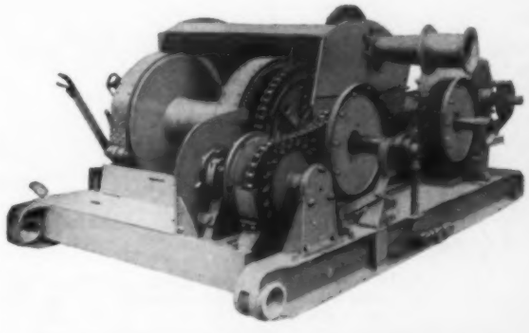

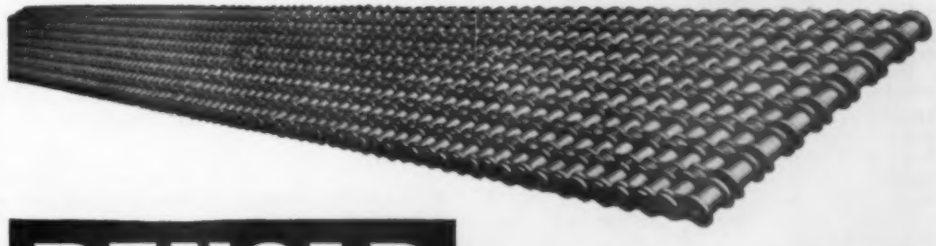

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ESSO PETROLEUM LTD. Fawley, Hythe, England.
Raw materials: virgin naphtha, C_3/C_4 olefins.
Products: ethylene, 40,000 ton/yr; butadiene, 40,000 ton/yr; heptene, 20,000 ton/yr, sulfur 20,000 ton/yr.
Construction: $2.8 million lube oil additives plant, with expected capacity of 14,000 long ton/yr. Planned: $15.5 million in additional facilities to produce ethylene, butylene, and propylene, by end 1961.

FORTH CHEMICALS LTD. (British Hydrocarbon Chemicals Ltd. and Monsanto Chemicals Ltd.). Grangemouth, Scotland. General manager, C. E. Evans.
Raw materials: ethylene and benzene.
Products: styrene monomer and toluene.
Construction: expansion in styrene to 50,000 ton/yr by end 1960.

GRANGE CHEMICALS LTD. (British Hydrocarbon Chemicals Ltd. and Oronite Ltd.) Grangemouth, Scotland. General manager, C. E. Evans.
Raw material: tetrapropylene and benzene.
Product: dodecyl benzene.

IMPERIAL CHEMICAL INDUSTRIES LTD. Billingham, England.
Product: anhydrous ammonia, 60,000 ton/yr.
Expansion: phenol being increased to 20,000 ton/yr, from current 15,000 ton/yr.

IMPERIAL CHEMICAL INDUSTRIES LTD. Heysham, Lancashire, England.
Products: methanol, 30,000 ton/yr.
An expansion to 75,000 ton/yr will be completed in 1962, according to present plans.

IMPERIAL CHEMICAL INDUSTRIES LTD. Severnside, Avonmouth, England, has long range plans for an eventual $282 million petrochemical facility. First phase involves $14 million on two plants to make 35,000 ton/yr of ethylene oxide, ethylene glycol, and associated products (from ethylene piped from Esso Petroleum's Fawley refinery), to be completed in 1962. Second phase will be $10 million, 100,000 ton/yr ammonia plant (and associated derivatives), to be completed in 1963.

IMPERIAL CHEMICAL INDUSTRIES LTD. Wilton, England.
Principal products: ethylene (about 130,000 ton/yr by end-1960), propylene (80,000 ton/yr), butylenes, polyethylene (105,000 ton/yr by end-1960), ethylene oxide, ethylene glycol (16,000 ton/yr), paraxylenes, hydrogen cyanide, acetone, butanol, isobutanol, polypropylene (10,000 ton/yr), alkylated phenols, butadiene, terephthalic acid, and many others.
Expansion: terephthalic acid, from current 20 million, to 50 million lb/yr, by end-1960.

INTERNATIONAL SYNTHETIC RUBBER CO. LTD. Fawley, Hampshire, England. General manager, D. A. Bennett.
Raw materials: butadiene and styrene.
Products: Synthetic rubbers, 70,000 ton/yr, to be raised to 100,000 ton/yr by 1961.

LOBITOS OILFIELDS LTD., Ellesmere Port, Cheshire, England.
Products: petroleum sulfonates, 150 b/d.

MANCHESTER OIL REFINERY LTD. Trafford Park, Manchester, England.
Products: petroleum sulfonates, 300 b/d. Facilities are being expanded.

MONSANTO CHEMICALS LTD. Fawley Works, Hythe, Hampshire, England.
Raw material: ethylene.
Product: polyethylene (rated capacity of 10,000 ton/yr already raised to 17,000 ton/yr, and further expansion is contemplated).
Planned: additional polystyrene and rubber chemicals capacity.

MONSANTO CHEMICALS LTD. Newport, South Wales, England, expects to complete a new 15 million lb/yr maleic anhydride plant this year.

OROBIS LTD. Salt End, Hedon, Hull, Yorkshire, England. Plant manager: H. Burnham.
Hydrocarbon raw materials, petroleum sulfonates, lube stocks, etc.
Products: lube oil additives, 3,000 to 5,000 ton/yr.

PETROCHEMICALS LTD. (Shell Chemicals Ltd), Carrington, Cheshire, England.
Raw material: naphtha.
Products: ethylene, propylene, ethylene oxide (45,000 ton/yr) polyethylene, propylene oxide, benzene, toluene, xylenes, isopropanol, glycol ethers, ethylene glycols, ethanolamines, polyethylene glycols, propylene glycols, polypropylene glycols, ethylene oxide condensates, phenols, cresols, alcohols, isopropanolamines, octyl phenol and octyl cresol condensates.
Ethylene oxide capacity is being increased by 20,000 to 45,000 ton/yr. A new 18,000 ton/yr monostyrene unit came on stream recently. A 30,000 ton/yr plant for polyethylenes and polypropylene is under construction.
Planned: commercial production of polybutadiene rubbers, with completion about 1963.

PHILBLACK LTD. Avonmouth, Bristol, England. General works manager, G. P. Jennings.
Hydrocarbon raw material: petroleum fractions, heavy residual oil.
Products: furnace blacks, 150,000 lb/yr.

SCOTTISH OILS LTD. Pumpherston, Midlothian, Scotland.
Raw material: shale oil fractions.
Product: detergents.

SHELL CHEMICAL CO. LTD. Shellhaven, Essex, England.
Raw material: refinery gases.
Products: dodecyl benzene (30,000 ton/yr), anhydrous ammonia (75,000 ton/yr), nitrogenous fertilizers, and sulfur.

SHELL CHEMICAL CO. LTD. Stanlow, Cheshire, England.
Raw material: refinery gases.
Products: some olefins sold to other manufacturers, the balance used to produce resins, solvents (40,000 ton/yr), sulfur, naphthenic acids, naphthenic sulfonates, and synthetic detergents. Plant produces naphtha feed for Carrington (Styrene Products Ltd.), sent by 23-mile underground pipeline.

STYRENE PRODUCTS LTD. (Shell Chemical Co. Ltd.) Carrington, Cheshire, England.
Products: polystyrenes.

UNION CARBIDE LTD., Chemicals Div., Hythe, Hampshire, England. Director and general manager: James F. Widman.
Raw material: ethylene (from Esso Petroleum at Fawley).
Products: ethylene oxide and derivatives, 45 million lb/yr.

UNION CARBIDE LTD., Polyethylene Div. Grangemouth, Scotland. Director and general manager: L. E. Whitmore.
Product: polyethylene (high pressure). Capacity is to be increased in 1960 to 60 million lb/yr.

WITCO CHEMICAL CO. LTD. Bush House, Aldwych, London, England, will build a plant in the Midlands of England with an initial capacity of 8 million lb/yr of a complete line of butadiene-styrene, high styrene, and nitrile latices, and other acrylic types.

Africa and Middle East

Algeria

The Algerian General Delegation's energy and industrialization department has announced a plan for a large scale petrochemical industry gased on Hassi R'Mel natural gas. Products would include ammonia, nitrogenous fertilizers and other petrochemical products.

Iran

IRANIAN GOVERNMENT plans a nitrogen fertilizer plant near Shiraz, Iran, to operate on natural gas, with a capacity of 110 ton/day. Montecatini is the licensor. Foster Wheeler is contractor.

Israel

Plans have been reported in Israel for a $6 million, 3,000 ton/yr ethylene plant in the Negev.

Asia and Far East

Australia

AUSTRALIAN CARBON BLACK PTY. LTD., Altona, Victoria, Australia.
Product: carbon black.

AUSTRALIAN PETROCHEMICALS LTD., Silverwater, near Sydney, Australia, has a $4.5 million, monostyrene plant scheduled for completion in 1961. General manager is M. R. Holmes.

AUSTRALIAN SYNTHETIC RUBBER CO. LTD. (Stanvac and Goodyear), Altona, Victoria, Australia, has an $11 million, 30,000 ton/yr synthetic rubber plant scheduled for completion at mid-1961.

CSR CHEMICALS, PTY, LTD. OF AUSTRALIA. Rhodes, New South Wales, Australia.
Product: polystyrene plastic.

CSRC-DOW PTY LTD., Altona, Victoria, Australia, is building a plant to produce monostyrene, ethylene dichloride, caustic soda, and chlorine, at a cost of about $12.5 million.

IMPERIAL CHEMICAL INDUSTRIES OF AUSTRALIA AND NEW ZEALAND LTD., Botany, near Clyde, Australia.
Product: polyethylene.
Plant is being expanded to operate on ethylene from nearby Shell Chemical when the latter plant goes on stream in 1962. Cost will be $5 million; expected capacity will be 5,000 ton/yr.

MONSANTO CHEMICALS (AUSTRALIA) LTD. and CONSOLIDATED ZINC PTY LTD. OF AUSTRALIA have formed a new jointly owned company which will initially manufacture fluorocarbons at Monsanto's present Sydney plant by about mid-1961.

PETROLEUM CHEMICAL CORP. (AUSTRALIA) LTD. Matraville, New South Wales, Australia. Plant manager: R. H. Mashford. Plant now being built, with completion target mid-1961, to produce 2.5 million Imp. gal/yr of benzene, 1 million Imp. gal/yr of toluene, 500,000 Imp. gal/yr of xylene, and 20 million lb/yr of monostyrene. The latter will actually be produced by Australian Petrochemicals Ltd (see separate listing).

SHELL CHEMICAL (AUSTRALIA) LTD. Clyde, Australia, will complete by 1962 a new 25,000 ton/yr, $22.4 million ethylene plant. A new $2.25 million epoxy resins plant was scheduled for completion this year.

SHELL CHEMICAL (AUSTRALIA) LTD. Geelong, Australia.
Product: sulfuric acid, 100 metric ton/day.
Under construction, a $2.8 million detergent alkylate plant, due for completion at end-1960.

UNION CARBIDE AUSTRALIA LTD., Melbourne, Australia, is constructing a 15 million lb/yr, $10 million polyethylene plant at Altona, with completion scheduled for mid-1961. Contractor is George Wimpey & Co. Ltd.

UNION CARBIDE (AUSTRALIA) LTD. will start production at a new plant at Rhodes, N.S.W., Australia, of Bisphenol A (diphenylolpropane), to be supplied to the epoxy resins plant being built by Shell at Clyde.

VACUUM OIL PTY LTD., Altona, Victoria, Australia. Managing director, E. A. Jones.
Raw materials: streams from Stanvac refinery.
Products: sulfur, 40 ton/day.
A new plant costing $35 million and scheduled for completion in mid-1961, will produce 45,000 long ton/yr of ethylene, 21,000 ton/yr of butadiene, and propylene, butylene, and derivatives.

India

ALKALI & CHEMICAL CORP. (subsidiary of Imperial Chemical Industries), West Bengal, India.
Product: polyethylene, 3,500 ton/yr (an $8.4 million plant completed in 1959).

INDIA GOVERNMENT has proposed a $50 million synthetic fertilizers plant near Bombay, India, to operate on refinery gases and fuel oil, with a capacity equal to 80,000 ton/yr of fixed nitrogen. Also under consideration is a synthetic rubber plant at Bareilly.

NATIONAL CARBON INDIA was scheduled to complete a 3,500 ton/yr polyethylene plant near Bombay this year.

NEYVELI LIGNITE plans completion in 1963 of a new $52 million, 500 ton/day urea plant at Neyveli, India. Contractors are Montecatini and Ansaldo.

POLYCHEM LTD. (associated with Dow Chemical), Fort Bombay, India.
Product: polystyrene.

SAHU CHEMICALS, Varanasi, India, will complete the following facilities this year: ammonia, 120 ton/day; ammonium chloride, 120 ton/day.

Indonesia

INDONESIAN GOVERNMENT will complete a $30 million ammonia plant near Palembang, Sumatra, in 1962, with capacity of 330 ton/day of fertilizer grade prilled urea, and to operate on natural gas. Foster Wheeler is the contractor.

Japan

ASAHI-DOW LTD. Kawasaki, Japan. Manager: Takeshi Hirose.
Raw materials: ethylene, benzene.

Products: monostyrene, 18,000 ton/yr; polystyrene, 16,800 ton /yr.

FURUKAWA CHEMICAL INDUSTRY CO. LTD. Kawasaki, Japan. Manager: Sadao Tsutsumi.
Raw material: ethylene.
Product: polyethylene, 9,000 ton/yr.

JAPAN SYNTHETIC RUBBER CO. LTD. Yokkaichi-shi, Miaken, Japan. Plant manager, K. Okajima.
Products: butadiene, 33,500 ton/yr; SBR synthetic rubber, 45,000 ton/yr.

JAPANESE GEON CO. LTD. (35% Goodrich, balance Furukawa Group). Kawsaki, Japan.
Raw materials: butadiene and styrene.
Product: SBR rubber, 5,000 ton/yr; high styrene rubber, 1,200 ton/yr; NBR rubber, 1,500 ton/yr.

KOKKAN CHEMICAL CO. 4, Chidori-cho, Kawasaki City, Japan (representative, Akimasa Yamamoto), plans a 13,000 ton/yr monostyrene unit at a cost of $2.22 million, and a 6,000 ton/yr polystyrene unit at a cost of $1.11 million.

KYOWA FERMENTATION INDUSTRY CO. LTD. Ube, Japan, plans a $20 million plant to produce butanol and octyl alcohol from naphtha.

MARUZEN OIL CO. LTD. Matsuyama, Japan. Manager: Tetsuo Oiwa.
Raw materials: Platformate.
Products: benzene, 3,100 ton/yr; toluene, 12,000 ton/yr; xylenes, 11,000 ton/yr; aromatic solvent, 6,000 ton/yr; terephthalic acid, 5,400 ton/yr.
Maruzen plans $1.94 million expansion in aromatics to add 3,000 ton/yr benzene, 9,600 ton/yr toluene, and 9,600 ton/yr xylenes.

MARUZEN OIL CO. LTD. Shimotsu, Wakayama Pref., Japan.
Raw materials: Refinery streams.
Products: benzene, 6,000 ton/yr; toluene, 3,600 ton/yr; xylenes, 3,600 ton/yr; sec-butanol, 2,400 ton/yr; methyl ethyl ketone, 1850 ton/yr; phthalic anhydride, 2,042 ton/yr; isophthalic acid, 5,000 ton/yr; terephthalic acid, 2,215 ton/yr; benzoic acid, 898 ton/yr.

MITSUBISHI OIL CO. Kawasaki, Japan. Manager: Toshio Kondo.
Raw material: reformate.
Products: benzene, 3,000 ton/yr; toluene, 7,200 ton/yr; xylenes, 6,000 ton/yr.
Planned: facilities for various dibasic acids—benzoinic, isophthalic—and phthalic anhydride.

MITSUBISHI MONSANTO CHEMICAL CO. Yokkaichi, Japan. Manager: Yoshiro Wakita.
Product: polystyrene, 7,200 ton/yr.
Planned: an expansion in capacity by 6,600 ton/yr, at a cost of $1.11 million.

MITSUBISHI PETROCHEMICAL CO. LTD. Yokkaichi, Japan. Managing Director: Tojiro Oka.
Raw materials: naphtha and waste gases.
Products: ethylene, 22,000 ton/yr; polyethylene, 10,000 ton/yr; monostyrene, 18,000 ton/yr; polystyrene, 7,200 ton/yr; ethylene oxide, 2,700 ton/yr; ethylene glycol, 3,000 ton/yr; benzene, 6,311 ton/yr; toluene, 6,700 ton/yr; xylenes, 4,800 ton/yr.
Planned: expansion in polyethylene by 15,000 ton/yr at cost of $6.67 million, as well as $1.67 million in new aromatics facilities to boost benzene by 6,300 ton/yr; toluene by 6,700 ton/yr; and xylenes by 4,800 ton/yr.

MITSUBISHI VONNEL CO. LTD. (owned jointly by Mitsubishi and Chemstrand Corp.) Hiroshima, Japan.
Product: acrylic fibers.

MITSUI PETROCHEMICAL INDUSTRY LTD. Iwakuni plant, Wakimura, Kuka-Gun, Yamaguchi Pref., Japan. Manager: Yasuji Torii.
Raw materials: naphtha and platformate.
Products: ethylene, 20,000 ton/yr; polyethylene, 12,000 ton/yr; ethylene glycol, 9,600 ton/yr; ethylene oxide, 12,000 ton/yr; phenol, 12,000 ton/yr; acetone, 7,200 ton/yr; terephthalic acid, 14,400 ton/yr; benzene, 6,000 ton/yr; toluene, 11,200 ton/yr; xylenes, 11,200 ton/yr; solvents, 12,000 ton/yr.
Planned: expansion in polyethylene by 18,000 ton/yr at cost of $8.61 million; 12,000 ton/yr monostyrene unit at $3.33 million; and 6,000 ton/yr polysterene unit at $1.94 million. Mitsui has applied for a license to manufacture polypropylene under contract with Montecatini.

NIPPON CATALYTIC CHEMICAL INDUSTRY CO. LTD. Kawasaki, Japan. Manager: Saburo Ishikawa.
Raw material: ethylene.
Products: ethylene oxide, 4,700 ton/yr; ethylene glycols, 3,800 ton/yr.
Expansion in ethylene glycol is planned, by 5,000 ton/yr, at cost of $280,000.

NIPPON OIL LTD. Kashiwazaki, west coast of Honshu, Japan.
Hydrocarbon raw materials: petroleum streams.
Products: isopropanol, 2,000 ton/yr; acetone, 3,500 ton/yr.

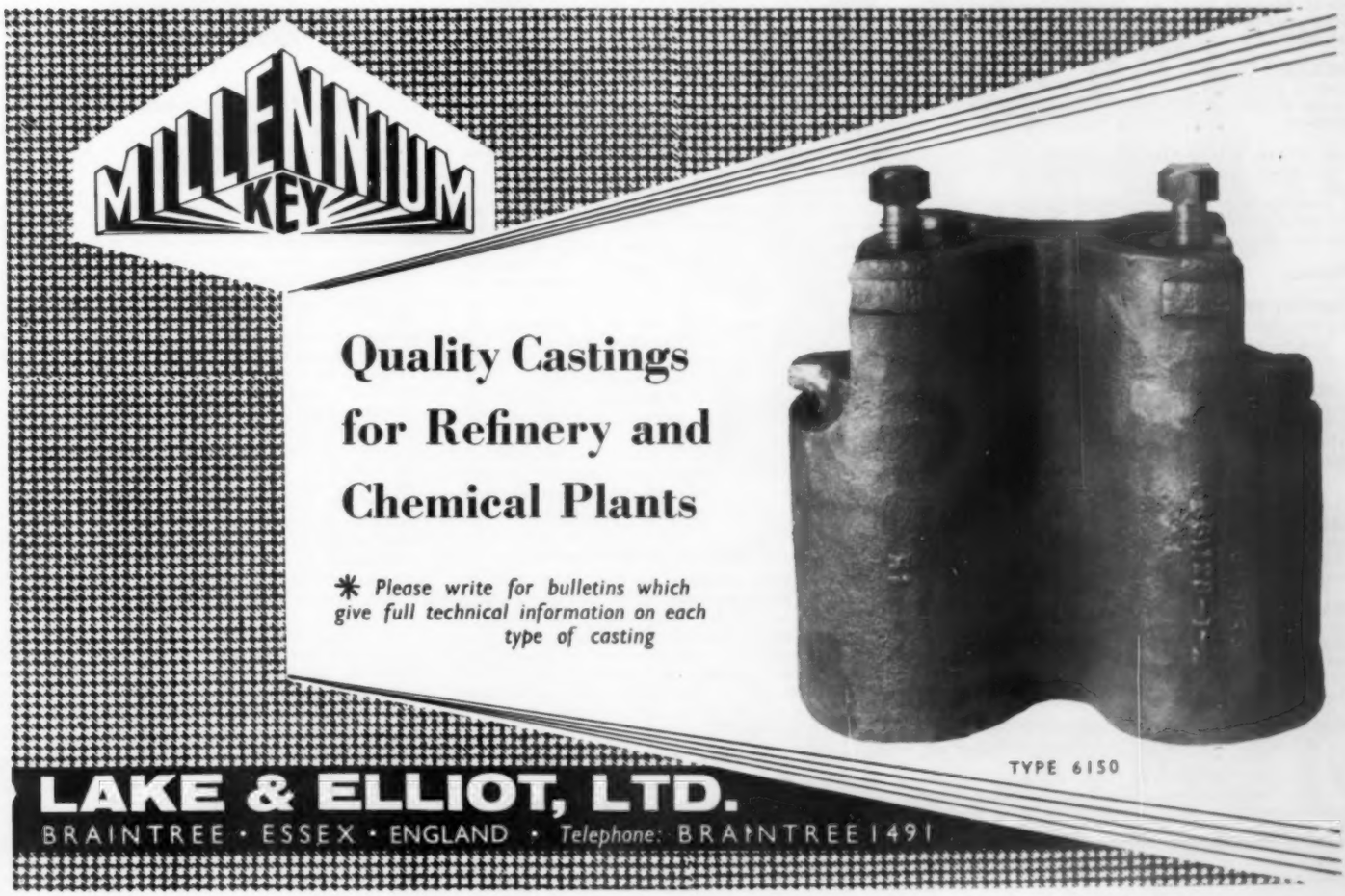
NIPPON PETROCHEMICALS CO. LTD. No. 8,543-3 Tako, Daishigawara, Kawasaki, Japan. Manger, Shoji Miwa.
Hydrocrbon raw materials: Lt. S. R. naphtha and cracking unit gas.
Products: ethylene, 35,000 ton/yr; butadiene, 8,000 ton/yr; isopropanol, 4,000 ton/yr; acetone, 4,500 ton/yr; isopropyl ether, 500 ton/yr.

NITTO CHEMICAL CO. Shin-maru Bldg., 1-4, Marunouchi, Chiyoda-ku, Tokyo, Japan, (representative, Takesada Akiba), plans a 20,000 ton/yr polyethylene plant at a cost of $9.44 million, and a 6,000 ton/yr ethylene glycol unit at $280,000.

SHOWA DENKO K.K. expects to complete by 1962 a new carbon black plant using a Phillips Petroleum licensed process. Plant site has not been disclosed. Company has also applied for license to manufacture polypropylene under contract with Montecatini.

SHOWA PETROCHEMICAL CO. Kawasaki, Japan. Manager, Ichiro Aihara.
Raw material: ethylene.
Product: polyethylene, 22 million lb/yr.

SUMITOMO CHEMICAL CO. LTD. Niihama City, Japan. Manager: Kaisuke Osumi.
Raw material: naphtha.
Products: ethylene, 12,000 ton/yr; polyethylene, 11,000 ton/yr.
Company has signed an agreement with Soc. Belge de l'Azote for design of a plant to produce acetylene and ethylene from liquid hydrocarbons. Sumitomo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plans to expand polyethylene by 15,000 ton/yr at a cost of $8 million. Company also has applied for a license to manufacture polypropylene under license with Montecatini.

TOA NENRYO Japan, has applied for a license to manufacture polypropylene under contract with Montecatini.

TOYO KOATSU. 8, Sanko-cho, Omuda City, Fukuoka Pref., Japan. Manager: Masayoshi Naito.
Company plans 25,000 ton/yr, $12.5 million polyethylene plant.

Korea

KOREAN GOVERNMENT has completed a $33.5 million, 285 ton/day urea plant at Chung-Ju.

Malaya

STANDARD-VACUUM OIL CO. LTD. will build a chemical fertilizer facility as part of a planned $30 million refining-petrochemical installation in Malaya. Wah Chang Corp., New York, will design and construct the plant.

Pakistan

BURMAH OIL CO. and **CONSTOCK INTERNATIONAL METHANE LTD.** are discussing possible carbon black plant in West Pakistan, to operate on gas from the Sui field. New company, Sui Carbon Co. Ltd., will be formed.

PAKISTAN INDUSTRIAL DEVELOPMENT CORP., Multan, West Pakistan, will complete a fertilizer plant operating on Sui fields gas, producing 103,000 ton/yr of ammonium nitrate and 59,200 ton/yr of urea.

PAKISTAN INDUSTRIAL DEVELOPMENT CORP. Fenchuganj, East Pakistan, will complete a $20 million synthetic fertilizer plant in November, 1961, to operate on Sylhet field gas. Expected production of urea will be 1.17 million lb/yr.

South Africa

AFRICAN EXPLOSIVES & CHEMICAL INDUSTRIES (subsidiary of Imperial Chemical Industries) expects to complete this year a 70,000 ton/yr synthetic ammonia plant at Nodderfontein, Union of South Africa. Plant would also produce methanol, formaldehyde, and urea-formaldehyde resins.

PHILLIPS CARBON BLACK CO. expects to complete a 22 million lb/yr carbon black plant in the spring of 1961 in the Union of So. Africa; site not disclosed.

S.A. COAL, OIL AND GAS CORP. LTD. Sasolburg, South Africa. Managing director: P. E. Rousseau.
Raw material: gasification of coal.
Petrochemical products: alcohols, 444,000 gal/yr; ketones, 200,000 gal/yr.

Taiwan

CHINESE PETROLEUM CORP. Chia-yee, Taiwan, Superintendent, Paul Hao.
Raw materials: napthas.
Products: solvents.

CHINESE PETROLEUM CORP. Kaohsiung, Taiwan. Manager, J. N. Hu.
Raw Materials: refinery and natural gas, naphtha.
Products: aromatics, sulfur (15 ton/day), carbon black.

USSR and Bloc

CZECHOSLOVAKIAN GOVERNMENT expects to complete a $30,000 ton/yr synthetic rubber plant in 1963, half of the eventual capacity. Site was not disclosed.

DIA-CHEMIEAUSRUESTUNGEN, East Germany, has ordered a $12 million, 40,000 ton/yr ethylene plant from a British group comprising Humphreys and Glasgow Ltd. and Petrocarbon Developments Ltd. Plant site was not disclosed, but first construction phase is due for completion by end of 1962.

POLIMEX, Oswiecim, Poland, will complete this year a $1.5 million, 35,000 lb/day polystyrene plant.

POLISH GOVERNMENT, Plock, Poland, plans a petrochemical plant as part of a new refinery project, expected to reach completion in 1965. Plant would use newly-discovered natural gas. One product planned is synthetic rubber at 60,000 ton/yr. Poland has contracted to deliver tires to Finland, Yugoslavia and Turkey.

UNION OF SOVIET SOCIALIST REPUBLICS (USSR). The Russian Government is buying a $6 million plant in England from Petrochemical Engineering Co. and Vickers Armstrong (Engineers) Ltd., to be delivered by the end of this year.

Several nations in the USSR sphere—Poland, East Germany, Romania, and Czechoslovakia—have held discussions in Warsaw, Poland with Imperial Chemical Industries Ltd. on a contract whereby ICI would provide polyethylene know-how. ICI said that plants contemplated would likely be in millions of annual pounds in capacity.

RUDNAP, Lukavaz, Bosnia, Yugoslavia, has signed an agreement with Montecatini and Ansaldo (both Italian) for construction of an $8 million synthetic fertilizer plant to produce anhydrous ammonia, 100 ton/day; nitric acid, 340 ton/day; and calcium nitrate, 380 ton/day.

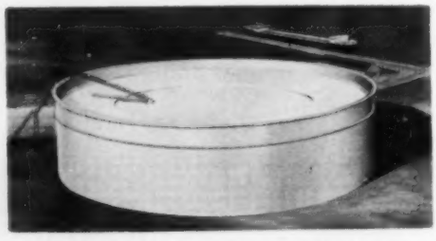
Cuba Takes Over Refineries

Virtually all of Cuba's refining capacity — some 82,000 out of a total of 86,600 b/d—was headed for governmental control as this issue went to press.

The 20,000 b/d Texaco refinery at Santiago was seized by the Castro regime June 29, when company officials refused to refine 300,000 tons of Russian crude oil during the balance of this year under terms of an agreement offered by the Cuban government whereby it would provide Texaco the dollar exchange necessary to pay for importations of crude it needs.

With very little crude left in storage, the other two major plants—Esso Standard's 35,000 b/d refinery at Belot and Shell de Cuba's 28,500 b/d plant at Havana—were expecting seizure by the Castro government a few days later.

All three companies have operated in the country many years: a Jersey affiliate for 78 years, Texaco for more than 50, and Shell for 35 years.



World's Largest Crude Oil Tank

Field construction of the world's largest crude oil storage tank has been started in Kuwait by the British subsidiary of Chicago Bridge & Iron Co. The giant steel tank will be 260 ft in diameter and 65 ft high, and have a capacity of 605,000 bbl. It is being built for American Independent Oil Co. in Mena Abdulla, on the Arabian Gulf. More than 1,500 tons of steel plate, fabricated in CB&I's eastern USA plant at Greenville, Penna., will be used in its construction by Chicago Bridge Ltd.

Eight steel rings—each 817 ft in circumference and 8 ft high—will form the shell. The first six are fabricated from T-1 steel, a special alloy of unusually high strength. The top two rings will be of carbon steel to A 131 practice. Welding of the girth joints will be done by CB&I's patented automatic welding process.

Within the tank shell, a Horton pontoon floating roof equipped with a Horton fabric seal will ride the surface of the crude oil, reducing evaporation loss, decreasing corrosion, and minimizing danger of fire.

Mobil Methyl in Venezuela

Mobil Methyl gasolines are now being sold in Venezuela, Mobil International Oil Co. said. These motor fuels are the first containing tetramethyl lead, a new anti-knock compound, to be sold outside the USA. The compound was announced in January by Mobil scientists, and the new gasoline has been marketed in Syracuse, N. Y. since May 24 at no increase in the wholesale price.

Gulf Advances Magee in Europe

Gulf Oil Corp.'s Petrochemicals Department has announced the appointment of Harry W. Magee as special representative—European Activities. With offices at Gulf House, No. 2 Portman St., London, Mr. Magee will devote a considerable portion of his time to the investigation and development of attractive petrochemical possibilities for the company, primarily in the European Common Market and the European Free Trade areas.

Mr. Magee has been manager of the manufacturing department of Gulf Eastern Co. in London since 1957. Prior to that post he had been manager of operations for Gulf's Philadelphia refinery. A native of Pittsburgh, and graduate of the University of Pittsburgh with a B.S. in Petroleum Refining, he has been with Gulf since 1931.

New Stimulation Technique

Dowell division of Dow Chemical Co. has been stimulating production in Permian Basin wells in West Texas and New Mexico by injecting acid under pressure but without the propping agents employed in normal fracturing. Two types of acids have been used, one for calcareous or dolomitic and another for siliceous rocks. Advantage of the method is that flow passages are not partly blocked by sand or other propping agents when pressure is removed. The technique has been applied to 30 wells thus far with good results in all cases.

Diamond Expands at Belle

Plans to initiate a long-range expansion program at the Belle, West Va., plant of the Chlorinated Products Division of Diamond Alkali Co. have been announced. The initial work will include erection of new buildings and replacement of operating equipment to utilize recent process improvements.

Modernization of facilities for production of methyl chloride, methylene chloride, and chloroform will result from the initial program, which is being started immediately.

P. V. Keyser, Jr.

Mobil Organizes Chemical Firm

Socony Mobil Oil Co. Inc. has created Mobil Chemical Co., an operating division to carry on activity in the petrochemical industry both in the USA and overseas.

Named president of the new chemical organization is Paul Keyser, Jr., currently a senior vice president of Socony Mobil. He becomes an executive vice president of the parent corporation.

Albert L. Nickerson, Socony Mobil's president, said the move is "a good deal more than a reorganization." He said the company needed a "flexible organization to concentrate exclusively on the profit-making potentials in chemicals." He would not predict in what directions the new enterprise might go, but said Mobil Chemical could make and sell new products and undertake joint ventures with others. "No avenues are closed," he said.

At the present time, the sale of chemicals and related products accounts for about $90 million of Socony Mobil's gross annual income.

The new company will be responsible for major petrochemicals produced at or near Socony Mobil facilities now in existence or under construction. This will include the world's largest high purity ethylene plant now being built at Beaumont, Texas, which will have a capacity of 380 million lb/yr when completed in 1961.

Mr. Keyser joined the company in 1930 after obtaining B.S. and MS. degrees from Massachusetts Institute of Technology. From 1943 to 1947, he was manager of the research and development department at Paulsboro, N. J. In 1947 he was made manager of the company's lubricating oil department and in 1951 general manager of domestic marketing. Mr. Keyser has been a director since 1951, and in 1959 was elected a senior vice president, and placed in charge of corporate planning.

George F. James, a director and senior vice president in charge of finance, assumes Mr. Keyser's former planning responsibilities. He becomes senior vice president—planning and finance.

Export Manager Named

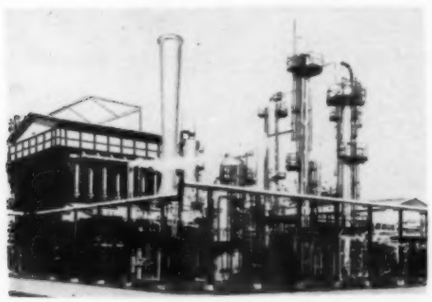
Appointment of Jim Sayers as foreign sales manager of Smith Tool Co. has been announced by Arthur S. Marshall, vice president-sales. Mr. Sayers will headquarter at the company's main offices and plant in Compton, California. He has been manager of Canadian operations in Edmonton.

Art Hawkins, formerly coastal division manager at Ventura, Calif., succeeds Mr. Sayers in Canada. Chuck Petrie becomes coastal division manager. He was formerly assistant division manager.

Solar to Build Ammonia Plant

A 300 ton/day ammonia plant and all offsite facilities will be designed and constructed near Joplin, Mo., for Solar Nitrogen Chemicals Inc. by M. W. Kellogg Co. The new plant will be designed to use the Kellogg steam methane reforming process as was the 300 ton/day plant Kellogg designed and engineered at Lima, Ohio, for the same client, and which went into operation in 1955.

Solar is owned equally by Standard Oil Co. (Ohio) and Atlas Powder Co. Atlas will operate the new plant and Sohio Chemical Co. will market the product. Completion is expected in one year.



The 300 ton/day ammonia plant designed and built at Lima, Ohio, for Solar Nitrogen by M. W. Kellogg.

H. C. Speel

A. H. Schutte

Speel Joins U.O.P.

Henry C. Speel, a 30-year veteran of the chemical industry, has joined Universal Oil Products Co., with responsibility for market research activities in chemical products. Formerly a partner in the consulting firm of Schwarz, Speel and Associates, he was previously director of development for Wyandotte Chemicals Corp., and has been associated with du Pont, Atlas Powder, General Mills, Alrose Chemical, and General Aniline & Film Corp.

Texaco Research Center

A new muti-million dollar research center will be constructed by Texaco, Inc. at Port Arthur, Texas, location of the company's largest USA refinery.

Requiring five years to complete, the new center will cost an estimated $7.5 million, and will provide Texaco with a second major petroleum research facility and one of the largest and most fully equipped such laboratories in the Southwest, the company said.

Occupying 35.2 acres, the center will comprise 15 separate laboratories and office buildings, six pilot laboratory bays, service buildings and enclosed storage areas, all set in a campus style arrangement and connected by covered walkways.

Although a number of basic research projects are to be carried on at the new center, most of the work will be on the pilot scale, as contrasted with the more fundamental research done at Texaco's Beacon, N. Y., Research Center.

Schutte Joins Little

A. Henry Schutte, has been appointed to the senior staff of Arthur D. Little, Inc., chemical engineering section. Formerly vice president of The Lummus Co., he has an extensive background in process technology in Europe, Indonesia, and the USA, with Lummus, and previously, with M. W. Kellogg Co. and Standard Vacuum Oil Co. Mr. Schutte holds patents in many areas of processing and process equipment.

New Australian Chemical Co.

A new, jointly owned chemical company will be formed in Australia by Monsanto Chemicals (Australia) Ltd., and Consolidated Zinc Pty. Ltd. of Australia to manufacture products in which both companies have common interest, particularly in the field of fluorine derivatives. Initially, the new company will produce fluorocarbons—chemical compounds used as refrigerants and as propellents for aerosols. These products presently are not manufactured in Australia.

The new company's manufacturing unit will be located at Monsanto Chemicals (Australia) Ltd.'s present plant site at Sydney and is expected to be operating by mid-1961.

Signal to Market in Europe

Signal Oil and Gas Co. has formed a new foreign subsidiary, Signal Europe, to market crude oil and products throughout Europe. Claude Geismer has been named president of the new marketing firm, which is headquartered in Paris, France.

Swartwout to New Hampshire

The Swartwout Division of the Crane Co., manufacturer of electronic process control instrumentation, has moved its production facilities and headquarters from Cleveland, Ohio, to Hooksett, New Hampshire. The company will maintain a Cleveland sales office at 21877 Euclid Avenue. The new plant covers 38,000 sq ft and can be expanded to meet company requirements.

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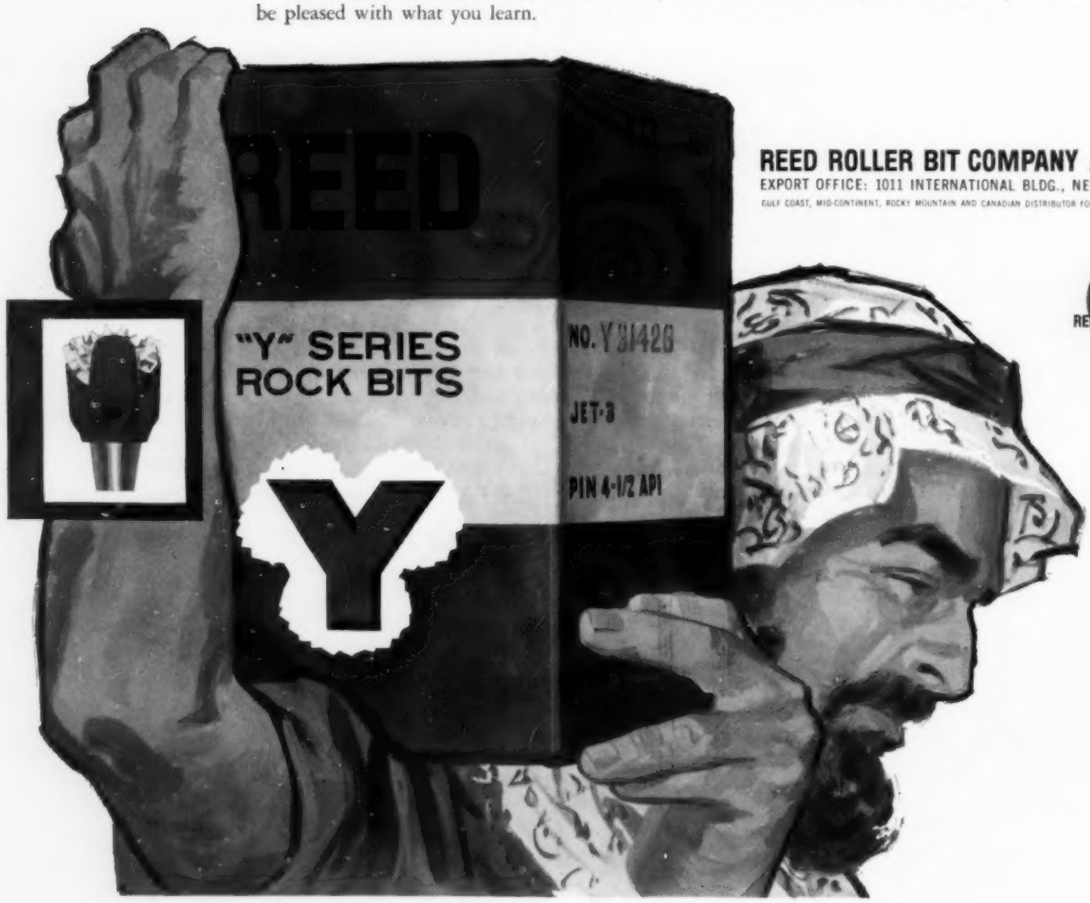

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